Automation System TROVIS 6400
Compact Controller
TROVIS 6493

Mounting and Operating Instructions

EB 6493-1 EN

Firmware version 2.03 and 3.03

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Modifications of firmware versions 2.03 and 3.03

The latest version of the TROVIS 6493 Compact Controller is equipped with an infrared interface. Apart from setting and operating the controller using the operator keys on the front panel, the integrated infrared interface allows you to configure, parameterize and operate the controller using the TROVIS-VIEW Configuration and Operator Interface.

The software for both compact controller versions has been upgraded:

- 6493-01 Firmware version 2.03
- 6493-02 Firmware version 3.03.

The measuring range of the reference variable (⍋ WINT, ⍓ WINT) is adapted automatically to the previously determined measuring range of the controlled variable (⍋ IN1, ⍓ IN1 or ⍋ IN2, ⍓ IN2). However, changing the measuring range of the reference variable afterwards does not result in an automatic adaption of the measuring range of the controlled variable (see section 3.3.1).

Automatic adaption in the CLAS function (see section 3.2.5):

The CLAS function enables you to assign the signals X and WE to the analog inputs IN1 and IN2. By default, X is assigned to input IN2, WE is assigned to input IN1. If, however, X is assigned to input IN1, WE is automatically assigned to input IN2. So far, WE had to be assigned manually to input IN2.

The parameter Y.PRE has been added to the PAR function.

This parameter determines the rate action of the output signal (see section 3.1).

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1 Notes

The TROVIS 6493 Compact Controller is a microprocessor-based controller with a flexible software design for the automation of industrial process plants. It is suitable for single control loops as well as for more complex control tasks. The flexible software design allows you to configure control circuits without changing the hardware. The read-only functions can be adapted to your specific plant configuration.

These Mounting and Operating Instructions (EB) describe the powerful features of the compact controller. First, we will explain how to operate the controller conveniently. All functions and parameters are described in section 3. Section 4 provides some practical examples to show you which settings need to be adjusted for the specific cases of application. In sections 6 and 7, the electrical connections and the installation are dealt with. The index at the end of this EB gives you quick and direct reference in case you have specific questions or problems.

- *The controller may only be installed, started up or operated by trained and experienced personnel familiar with the product.*
  According to these mounting and operating instructions, trained personnel refers to individuals who are able to judge the work they are assigned to and recognize possible dangers due to their specialized training, their knowledge and experience as well as their knowledge of the applicable standards.
- *The controller has been designed for use in electrical power systems. For wiring and maintenance, you are required to observe the relevant safety regulations.*
- *Proper shipping and appropriate storage are assumed.*

2 Operation

The TROVIS 6493 Compact Controller can be operated either directly using the keys on the front panel or using the TROVIS-VIEW Configuration and Operator Interface (see section 2.7) for configuration, parameterization and operation.

In the following, we will explain how to operate the controller with the keys on the front panel. First, open the folded back cover of this EB. There is the controller's front panel with its display and six keys. Principally, there are two levels which provide different key functions and different displays: the operating level and the setup level. You may define the functions of the compact controller via configuration and parameterization. A table listing all details required for parameterization and configuration is provided in Appendix A. In addition, we will explain how to configure and parameterize using this table in section 2.6.

2.1 Display

Depending on the selected level, the display shows the following variables and operating states (see folded back cover):

No.	Operating level	Setup level
1	Controlled variable X	Designations, settings and values of functions, parameters; abbreviations are listed in Appendix A
2	Value assumed by W, W2, WE, Y or Xd	
3	Limit relay L2 active	Not displayed
4	Three-step output –	Not displayed
5	Limit relay L1 active	Not displayed
6	Three-step output + or two-step output	Not displayed
7	Alarm messages (see section 3.2.3)	Not displayed
8	Hand icon displayed in manual mode No icon in automatic mode	Not displayed
9	Press the key to display W, W2, WE, Y or Xd% in sequence. The associated value appears in (2). W2 and WE only when they have been activated (see section 3.3.1).	⊻ and ⊼ are used for minimum and maximum values of different parameters.
10	Bar graph display of Xd in percent	Not displayed

2.2 Keys

The compact controller is operated using six keys whose function depends on the selected level.

Key	Function in operating level	Function in setup level
Enter key (yellow)	Provides access to setup level. Activates a new reference variable if its icon (W, W2 or WE) **blinks** in the display (9).	Activates functions and parameters to be changed (display blinks). Confirms new settings of functions or parameters (display stops blinking).
Selector key	Switches lower display section between: W internal reference variable 1, W2* internal reference variable 2, WE* external reference variable, Y continuous output variable, Xd% error * Only when selected, see p. 27.	Provides access to parameter level. Jump within the value range in parameter level.
Manual/automatic key	Changes from manual to automatic mode and vice versa. In manual mode, ✋ appears.	No function
Cursor keys	Change the value of W or W2 when they are displayed in the lower display section. Change controller output in manual mode, and when Y is indicated in the lower display section.	Browse within the main groups, functions, settings and parameters. Change function settings and parameter values.
Return key	Displays the current reference variable.	Return to preceding level up to operating level.
No key pressed	After approx. 5 minutes, display changes to current reference variable. Exception: in manual mode and when output variable is displayed	Changes to operating level after approx. 5 minutes.

2.3 Operating level

In the operating level, you can	Press		Comments
view different variables: W, W2, WE, Y, Xd		Press selector key repeatedly until the desired variable appears on the display.	W2 and WE are only displayed when you have activated them in SETP (see section 3.3.1).
select another reference variable		Press selector key repeatedly until the desired reference variable (W, W2 or WE) is displayed.	When the reference variables are deactivated, W, W2 or WE blink. Whereas they do not blink when active.
		Press the enter key.	
change the value of the internal reference variable W or W2		Press selector key repeatedly until W or W2 appears.	New value is accepted at once. No confirmation required.
		Change the value using the cursor keys.	
switch to manual mode		Press manual/automatic key.	In manual mode, use the cursor keys to determine the output variable.
change the output variable		Press manual/automatic key to display Y.	
		Change its value using the cursor keys.	
enter setup level for configuration and parameterization		Press enter key.	Do not press the enter key when W, W2 or WE blink, otherwise you activate a new reference variable!

2.4 Setup level

This level enables you to configure and parameterize the compact controller. You can enter the setup level from the operating level by pressing the enter key once. Here, you may adapt preset functions to your specific needs (configure) and change parameters. The functions are arranged in nine main groups:

- PAR (control parameters)
- IN (input functions)
- SETP (reference variable)
- CNTR (control structure and functions)
- OUT (output functions)
- ALRM (alarm functions)
- AUX (additional functions)
- TUNE (start-up adaption)
- I-O (view process data)

The parameters are always connected to the function they are assigned to.

This means that pressing [⊡] allows you to access only the parameters that are relevant for the particular function you have chosen.

Appendix A lists all functions and parameters provided by the compact controller. The table includes the main groups and their functions with the setting options in the left column, and the associated parameters in the right column. This table will considerably facilitate learning how to operate the controller. You only have to keep the following in mind:

To move from left to right (in columns), press [ ].

To move in the reverse direction (from right to left), use the return key [↵].

The key number (KEY) must be entered in setup level only when a function or parameter is changed for the first time.

The right column of the table, i.e. the parameters, can be accessed by pressing the selector key [⊡]. Again, press the enter key to move forward in columns.

To move in rows from top to bottom, press [△].

To move in reverse direction, press [▽]. Confirm new settings or the new value by pressing [ ].

An example in section 2.6 illustrates how to configure and parameterize the controller properly.

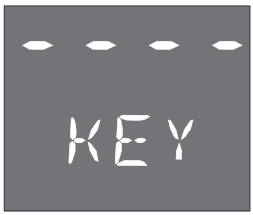
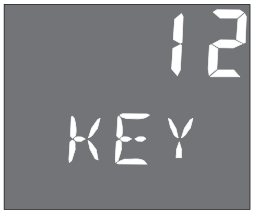
Note!

The display changes from setup level to operating level after 5 minutes when no key is pressed!

2.5 Key number

You are prompted to enter the key number when you want to change the settings of functions and parameters.

The compact controller can be operated with or without a key number. Factory default is without key number. Each time you wish to change a function or parameter in the setup level for the first time, you will be prompted to enter the key number. Proceed as follows:

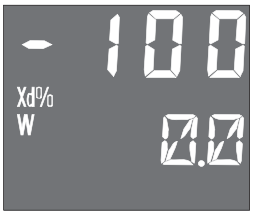
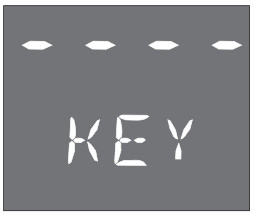
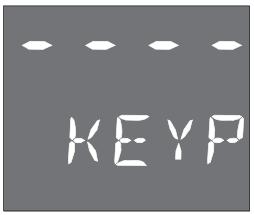
Press	Reading on display	Comment
		KEY blinks. Enter the key number. Skip the next step for operation without key number. **Note!** If the reading on the display looks like this, the key number can always be changed (see next section).
△ or ▽		KEY blinks. Enter the valid key number. In this example it is 12.
□	If you have entered the correct key number, the selected function blinks in the display. If not, you are prompted to enter the key number again with 1 appearing in the upper display section. This means that the controller operates with key number. Enter the key number again or cancel by pressing the return key ↵.	

Changing the key number

You may define a new key number or set up the controller to operate without key number.

When defining a new key number, you need to know the service key number which is to be found on page 104. To prevent misuse, you should cut it out or make it unreadable.

Proceed as follows to define a new key number:

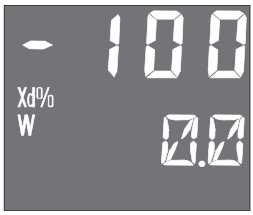
Press	Reading on display	Comment
		You are in operating level. The reading on the display looks like this.
☐ 3x		KEY blinks. **Note!** If the reading on the display looks like this, the key number can always be changed.
△ or ▽		KEY blinks. Enter the service key number. See page 104.
☐		You have confirmed the service key number. You now see KEYP which stands for key number programming. The upper display section shows the current key number. The four dashes stand for "without key number".
△▽		Enter the new key number (---- for "without key number"). We have chosen 12 in this example.

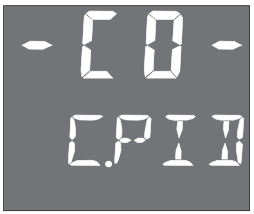
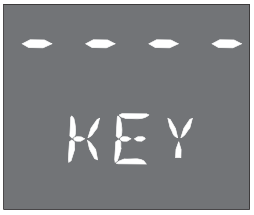
Press	Reading on display	Comment
☐		You have confirmed the new key number and returned to the selected function or parameter. In our example, we have returned to the Kp value.

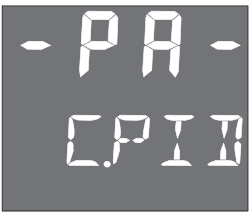
2.6 Example for configuration and parameterization

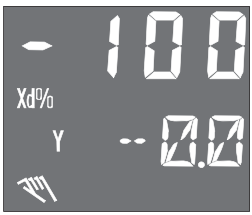
We will use the "Table of functions and parameters" provided in Appendix A for this example. The exercise consists of setting up the controller as a PID controller and adjusting the parameters accordingly.

The biggest problem is of course where to find the appropriate function and what to change in this function. There are two ways to proceed. You may search for the function in the table in Appendix A, which also provides reference to further details. Or you may refer to the index. For the PID controller, you will find the C.PID function which belongs to the main group CNTR. As you already know which main group is to be activated and which function is to changed, proceed as follows:

Press	Reading on display	Comment
		You are in operating level. The display reading will be similar to the one depicted here.
☐		You have entered the setup level. The display shows the first main group PAR. Main groups are always displayed in a single line. You are now in the first column of the table in Appendix A. **Note!** If you press the enter key again, you get to Kp (see page 14).
△		

Press	Reading on display	Comment
△ repeatedly until CNTR appears on the display.		Browse through the main groups (in the table in Appendix A, you move from top to bottom) until you get to the main group CNTR. Here, you can adjust the dynamic behavior of the controller output.
□		You have entered the main group CNTR (moved to the right in table). You have reached the functions. Functions are always marked by -CO- for configuration. The display shows the first function C.PID, "Dynamic behavior of controller output". In our case, the function we were looking for.
□		You have moved one column further to the right. You now see the current settings of the PI action function. These settings are to be changed to PID action.
□ KEY blinks		You are prompted to enter the key number (KEY). This prompt is displayed when you change a function for the first time after entering the setup level. You will not be prompted for subsequent changes. If you do not use a key number, skip the next step.
△ or ▽		Use the cursor keys to enter the key number. In our example it is 27.

Press	Reading on display	Comment
☐		The display will look like this if you have entered the key number correctly. If not, you will be prompted again. The upper line blinks, meaning that you may change the settings of the function. In the table, you have moved one column further to the right and have reached "Setting options".
△ or ▽		The upper line blinks. Use the cursor keys to select the desired setting. In our example it is Pld for PID action of the controller output.
☐		Confirm changes with the enter key. The upper line stops blinking. The first part of the task is completed. Now the control parameters KP, TN and TV are to be changed. To do so, enter the parameter level.
⇆		Press the selector key to open the parameter level. In the table, you have jumped to the first column on the right page. C.PID and CP.YP are displayed alternately in the lower display line.
☐		The first parameter Kp is displayed. **Note!** You can go directly from the PAR display to this display by pressing the yellow enter key once. You may only change the control parameters KP, TN, TV and Y.PRE.

Press	Reading on display	Comment
□		KP blinks, i.e. you can change this parameter.
△ or ▽		Enter a new value for KP. In our example it is 1.5. The upper line continues to blink.
□		You have confirmed the new value for KP. The upper line stops blinking.
△		The next parameter is displayed. To change this and other parameters, proceed as described for KP, i.e. repeat the steps in the fields highlighted in gray.
↵ repeatedly until the display looks like this!		You are back in the operating level. ✋ indicates that the compact controller is in manual mode.

2.7 TROVIS-VIEW Configuration and Operator Interface

The TROVIS 6493 Compact Controller can be configured, parameterized and operated using SAMSON's TROVIS-VIEW Configuration and Operator Interface via the infrared interface integrated in the front panel.

Operating TROVIS-VIEW is similar to working in Windows Explorer. Apart from configuration, parameterization and operation, TROVIS-VIEW provides additional features to record the compact controller. These are, for example, editing plant texts, saving and printing various configuration and parameterization data, tabulating analog inputs and outputs as well as binary status reports.

The TROVIS-VIEW software with the device-specific module for the TROVIS 6493 Compact Controller is delivered on a CD-ROM (order no. 6661-1031).

For system requirements, refer to the TROVIS-VIEW Data Sheet T 6661 EN or to the readme.txt file in the root directory of the CD-ROM.

Communication between the PC and the compact controller is established via the infrared interface integrated in the controller. The IR interface can be accessed via the controller's front panel. It is located to the left of the yellow enter key (see Fig. 1).

An infrared adapter (order no. 8864-0900) is required to transfer data between the PC's serial RS-232 interface and the controller's integrated infrared interface.

Note!

For additional information on installation, connection and operation, refer to the Mounting and Operating Instructions EB 6493-2 EN.

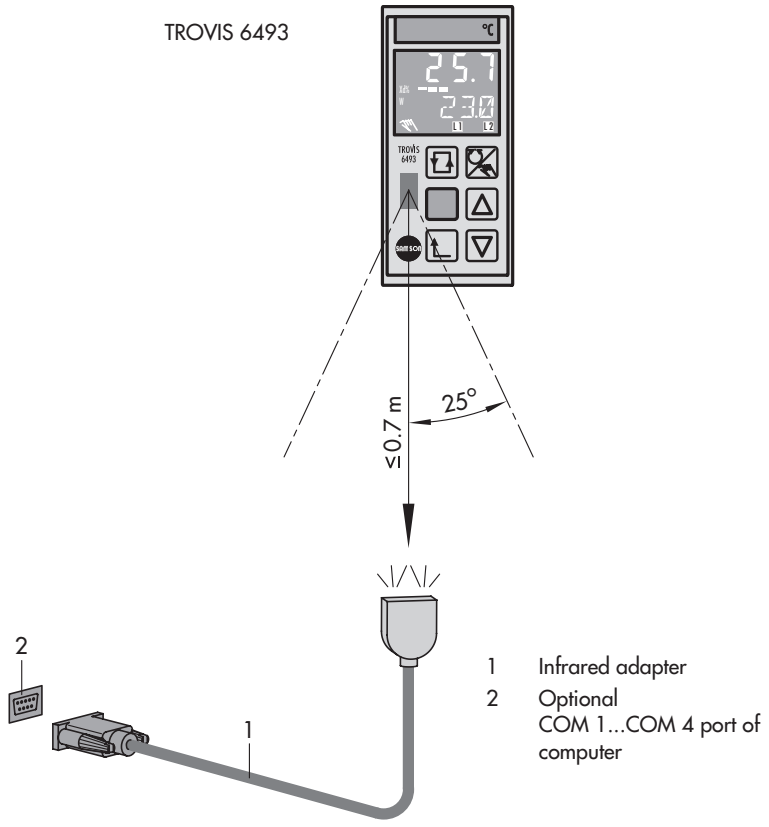


Fig. 1 · Connecting an infrared adapter

3 Functions of the compact controller

In this section, all functions of the setup level are described. We assume that you are familiar with the operation of this controller and know how to change functions and parameters.

The compact controller contains nine main groups: PAR, IN, SETP, CNTR, OUT, ALRM, AUX, TUNE and I-O. Each of the sections 3.1 to 3.9 is dedicated to one of the main groups. The main groups have different functions which can be identified by -CO- displayed in the upper display section. The functions are explained in the subsections (e.g. 3.2.1); the subsection titles already indicate the functions' designation. Almost every function provides different setting options from which you can choose one to adapt this function to your specific needs. The setting options of the functions are marked with a small grey square in these instructions. If you need to adjust parameters for your function, they will be specified and explained, if necessary. The value range of the parameters and factory defaults can be found in Appendix A.

3.1 PAR Control parameters

This main group serves a special purpose. In contrast to all other main groups, it does not include any functions. When you open this level, the controller immediately jumps to the parameter level where the control parameters Kp, Tn, Tv and Y.PRE can be set.

This main group allows you to quickly set the control parameters. You may also adjust the same settings in the main group CNTR, with the C.PID function.

3.2 IN Input functions

This main group defines all the functions of the two analog inputs In1 and In2. You may specify the input signal range and assign the analog inputs to the controlled variable X or the external reference variable WE. In addition, you can determine the measuring range of both signals. You may also perform measuring range monitoring. Moreover, the input signal can be filtered or functions may be generated from it.

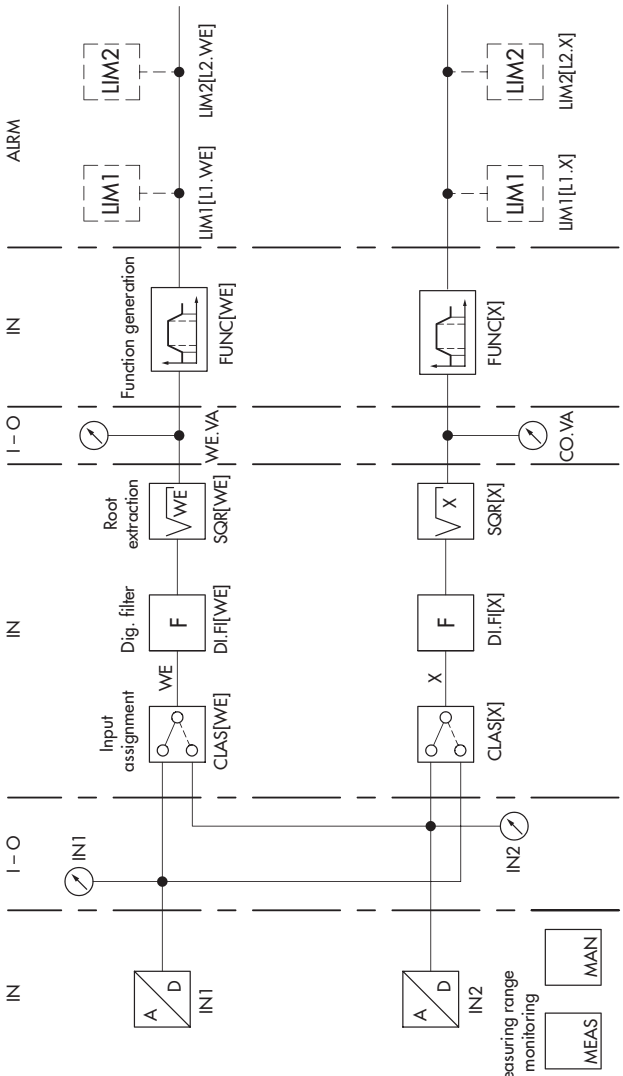


Fig. 2 · Main group IN

3.2.1 IN1 Input signal range IN1

This function enables you to define the input signal type and range for the analog input In1. The parameters' lower and upper range values must be given as absolute values.

Choose between:

- 0-20 mA 0 to 20 mA input
- 4-20 mA 4 to 20 mA input
- 0-10 V 0 to 10 V input
- 2-10 V 2 to 10 V input

Parameters to be set

- ⊻ IN1 Lower range value as absolute value
- ⊼ IN1 Upper range value as absolute value

3.2.2 IN2 Input signal range IN2

Note that there are two hardware versions for the analog input In2: controller version 6493-01 (model no. on the name plate) has a temperature sensor or potentiometer input, whereas controller version 6493-02 has a mA input.

This function enables you to define the input signal type and range for the analog input In2. The measuring range must be specified with the parameters IN2 and ⊼ IN2. Make sure that the span is not smaller than 100 °C.

Choose between:

- 100 PT Pt 100 resistance thermometer, hardware range –100 to 500 °C
- 1000 PT Pt 1000 resistance thermometer, hardware range –100 to 500 °C
- 100 NI Ni 100 resistance thermometer, hardware range –100 to 500 °C
- 1000 NI Ni 1000 resistance thermometer, hardware range –60 to 250 °C
- 0-1 KOHM 0 to 1000 Ω input

Parameters to be set

- ⊻ IN1 Lower range value as absolute value
- ⊼ IN1 Upper range value as absolute value

This function enables you to define the input signal type and range for the analog input In2. Enter the lower and upper range values as absolute values of the parameters you require.

Choose between:

- 0-20 mA 0 to 20 mA input
- 4-20 mA 4 to 20 mA input

Parameters to be set

⊻ IN2 Lower range value as absolute value

⊼ IN2 Upper range value as absolute value

3.2.3 MEAS Measuring range monitoring for analog input 1 and 2

This function enables you to define whether the measuring ranges of the analog inputs are to be monitored either for exceeding or falling below the measuring range.

Choose between :

- oFF ME.MO No measuring range monitoring
- In1 ME.MO Measuring range monitoring of analog input IN1
- In2 ME.MO Measuring range monitoring of analog input IN
- ALL ME.MO Measuring range monitoring of both analog inputs IN1 and IN2

When values exceed or fall below the measuring range, this is signalized on the display by the alarm message icon . The binary output is set for alarm messages. In addition, "__o1" blinks in the upper display section when values exceed the measuring range, "__u1" blinks when values fall below the measuring range of analog input 1, or of the analog inputs 1 and 2. When analog input 2 exceeds or falls below the measuring range, " __o2" or "__u2" appears on the display. Whenever values exceed or fall below the measuring range, the compact controller can change to manual mode (see section 3.2.4).

3.2.4 MAN Changeover to manual mode upon transmitter failure

This function enables you to define whether the controller switches to manual mode, and which output value is generated when the measuring range is exceeded or not reached. This function only becomes effective when measuring range monitoring has previously been activated in the MEAS function (see previous section 3.2.3). Manual mode is easily recognizable by on the display.

Choose between:

- oFF FAIL No changeover to manual mode upon transmitter failure
- F01 FAIL Changeover to manual mode with constant output value Y1K1
- F02 FAIL Changeover to manual mode with last output value received

Parameter to be set

Y1K1 Constant output value

Note!
When values exceed or fall below the measuring range, Y1K1 only becomes effective when the compact controller is in automatic mode.

The parameter Y1K1 can also be set in the main group OUT via the SAFE function as well as in the main group AUX via the RE.CO function (see sections 3.5.1 and 3.7.1).

3.2.5 CLAS Assignment of X and WE

Internally, the compact controller operates with the analog input signals X and WE. The CLAS function is used to assign these signals to the analog inputs IN1 or IN2. By default, X is assigned to analog input IN2 and WE to analog input IN1.

Assignment of X

- IN1 X X assigned to analog input IN1
- IN2 X X assigned to analog input IN2

Assignment of WE

- IN1 WE WE assigned to analog input IN1
- IN2 WE WE assigned to analog input IN2

3.2.6 DI.FI Filtering of input variable X and WE

This function enables you to determine whether X and/or WE are to be filtered.

The first-order filter (low-pass filter or Pt1 behavior) smooths the selected signals and suppresses input signal interferences of higher frequency.

The time constant of the Pt1 element is defined by the parameter TS.X for the input signal X, and by TS.WE for the input signal WE. The time constant is given in seconds.

Filtering of input variable X

- oFF X Filtering of input variable X deactivated
- on X Filtering of input variable X activated

Filtering of input variable WE

- oFF WE Filtering of input variable WE deactivated
- on WE Filtering of input variable WE activated

Parameters to be set

TS.X Time constant X filter in seconds
TS.WE Time constant WE filter in seconds

3.2.7 SQR Root extraction

This function enables you to root-extract the signals X as well as WE. Thus, you may easily calculate the flow rate from a differential pressure, for example. Choose between:

Root extraction X

- oFF X No root extraction of signal X
- on X Root extraction of X

Root extraction WE

- oFF WE No root extraction of signal WE
- on WE Root extraction of WE

3.2.8 FUNC Function generation of X and WE

You may apply function generation to the signal X as well as to WE. Choose between:

Function generation of X

- oFF X No function generation of signal X
- on X Function generation of X

Function generation of WE

- oFF WE No function generation of signal WE
- on WE Function generation of WE

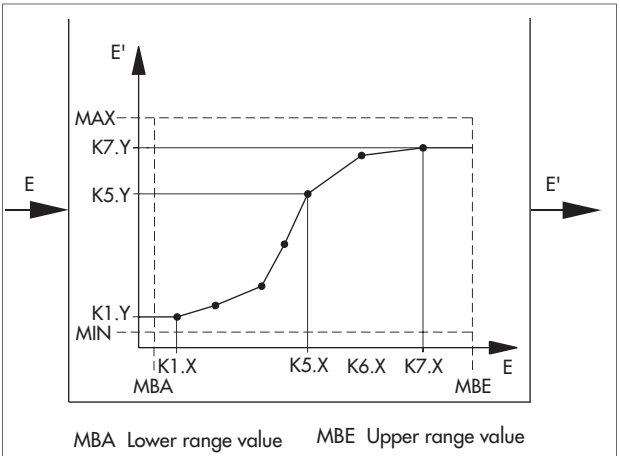


Fig. 3 · Example of parameter for function generation

Function generation means that a signal is re-evaluated to be further processed. This allows you to adapt auxiliary, reference or equivalent variables required for measuring and control to your specific control loop. For this purpose, you must specify 7 points to characterize the relationship between signal E to be function-generated (X or WE) and the desired new output signal E' (X' or WE'). This relationship should be known to you either from physical laws, experience or from calculated values (e.g. the relationship between steam pressure and temperature). We recommend that you either draw up a table or create a curve in a Cartesian coordinate system. Choose the 7 points in such a way that a curve can easily be created by drawing straight lines between two adjacent points.

The points are entered via the parameters K1.X to K7.X for the input signal, and K1.Y to K7.Y for the output signal. The values are entered as absolute values, i.e. in units of measurement comprehensible to the user (e.g. in °C, bar or %).

Even when the signal curve can be sufficiently characterized by less points, 7 points must be specified. If applicable, they can be defined in the same position as the last point.

The parameters MIN and MAX are used to determine the measuring range of the output signal E'. It corresponds to that of signal E (not function-generated) with reference to the output signal E'. By entering these two parameters, a proper basis for the percentage calculation performed by the software is created.

If K1.Y or K7.Y do not agree with MIN and MAX, the output values for the function-generated signal, which are below or above these limits, are constantly set to K1. Y or K7.Y. In doing so, the compact controller completes the polygonal curve by generating straight lines (see Fig. 3).

If you have entered an output value greater than MAX or smaller than MIN, it will be set to the value of MAX or MIN.

You will find an application example for function generation in section 4.3.

Note!
The course of the polygonal curve is not limited by the software. Polygonal curves with more than one maximum or minimum are possible. However, make sure that you assign only one ordinate value to one abscissa value. Otherwise, you risk to lose clear assignment of the input signal.

Parameters to be set

MIN	Lower range value of output signal
MAX	Upper range value of output signal
K1.X to K7.X	Input values for points 1 to 7
K1.Y to K7.Y	Output values for points 1 to 7

3.3 SETP Reference variable

This main group enables you to determine one or more reference variables, and you can switch between them as required. The compact controller has two internal reference variables W and W2 for fixed set point control. However, you must activate W2 to use it. The default setting of the controller is fixed set point control. To obtain follow-up control, you only need to activate the external reference variable WE. However, the input WE can also be used for fixed set point control, serving as an input for the position transmission of a three-step output with external position feedback, or as feedforward control. If you want to activate one of these control modes, you need to adjust them in this main group. Moreover, you may select a set point ramp with various starting conditions.

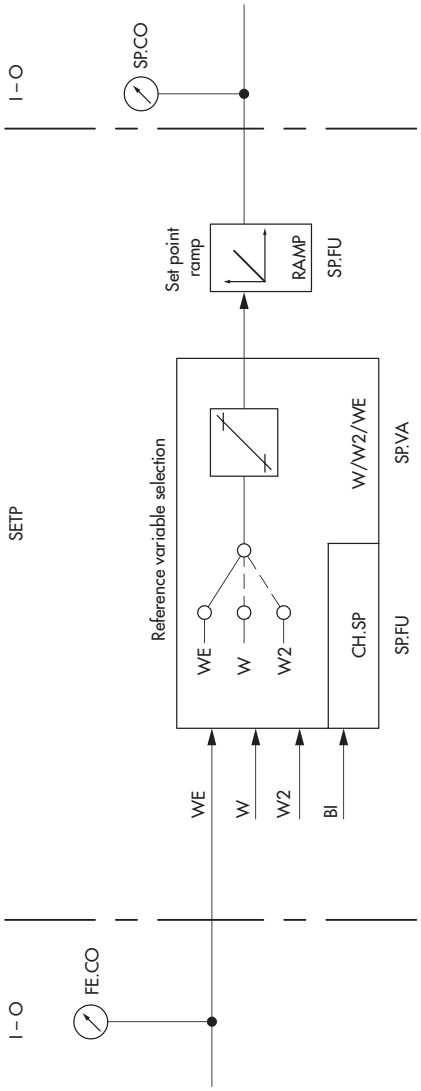


Fig. 4 · Main group SETP

3.3.1 SP.VA

This function enables you to define which reference variables are active: W, W2 and/or WE. When you activate WE, follow-up control will automatically be effective, unless you use WE as input for the position transmission of a three-step output with external position feedback (F01 WE), or for feedforward control (F02 WE).

Parameter level allows you to define the desired value of the reference variable (W, W2) and its measuring range (⍋ WINT, ⍍ WINT). This range must be identical to the measuring range of the controlled variable (⍋ IN1, ⍍ IN1 or ⍋ IN2, ⍍ IN2). You may limit this measuring range with the parameters ⍋ WRAN and ⍍ WRAN. The value of the reference variable can only be chosen between ⍋ WRAN and ⍍ WRAN. This also applies in operating level.

Choose between:

Internal reference variable W

- on W Internal reference variable W, always active

Parameters to be set

W	Internal reference variable W
⍋ WINT	Lower range value for W, W2, WE
⍍ WINT	Upper range value for W, W2, WE
⍋ WRAN	Limitation of W, W2, WE, lower limit
⍍ WRAN	Limitation of W, W2, WE, upper limit

Internal reference variable W2

- oFF W2 Internal reference variable W2 not active
- on W2 Internal reference variable W2 active

Parameter to be set

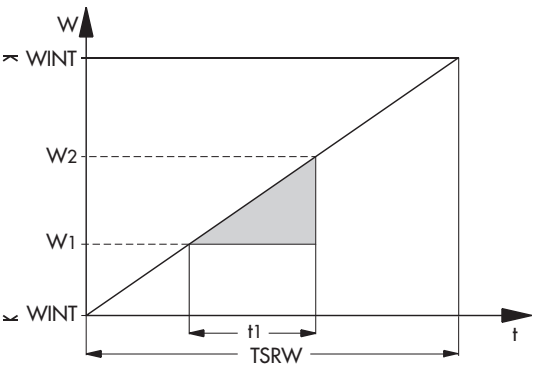
W2 Internal reference variable W2

External reference variable WE

- oFF WE External reference variable not active
- on WE External reference variable active
- F01 WE WE as input for external position feedback with three-step output
- F02 WE WE as input for feedforward control (in this case, WE is not displayed in operating level! It is only displayed in I-O level; see section 3.9.3).

3.3.2 SP.FU

This function enables you to define a set point ramp and change between the different reference variables via the binary input.



WINT	Upper range value	W1	Old value of ref. variable
WINT	Lower range value	W2	New value of ref. variable
TSRW	Transit time of set point ramp	*t1*	Actual transit time of set point ramp

Fig. 5 · Set point ramp

Set point ramp means that the reference variable changes at a constant rate. When the reference variable is changed, the compact controller follows this change with a certain delay to prevent oscillations. The transit time of the set point ramp is determined by the parameter TSRW. TSRW refers to the entire defined measuring range, e.g. WINT and WINT. When the reference variable changes from a value W_1 to a new value W_2, the actual transit time of the set point ramp is the time t_1, as illustrated in Fig. 5.

You may start the set point ramp via the binary input, and choose between two starting values (actual value or parameter WIRA). The set point ramp can also be active upon each change of the reference variable.

$$TSRW = t_1 \times \frac{| \overline{W}INT - \underline{W}INT |}{| W2 - W1 |}$$

Choose between:

Set point ramp

- oFF RAMP — Set point ramp deactivated
- F01 RAMP — Set point ramp starts with BI1 and actual value
- F02 RAMP — Set point ramp starts with BI1 and WIRA
- F03 RAMP — Set point ramp activated, no starting conditions

Parameters to be set

TSRW	Transit time of set point ramp in seconds
WIRA	Starting value of reference variable as absolute value

You can use the binary input to change between the internal and external reference variable:

Changeover of W via BI1

- oFF CH.SP — No changeover between internal reference variable W (W2) and external reference variable WE
- F01 CH.SP — Changeover between active internal reference variable W (W2) and external reference variable WE via binary input BI1
- F02 CH.SP — Changeover between internal reference variables W and W2 via binary input BI1. If W2 is active when setting the binary input, no function will be performed. The function -CO- SP.VA may not be set to "ON" for WE.

Note!
Several functions may be assigned to the binary input!

3.4 CNTR Controller structure and functions

This main group enables you to determine the functions for the control algorithm. You may define the dynamic behavior of the controller output, the operating direction of the error and the output variable. In addition, you may select the input variable for the D element and set a control mode changeover. If you use the input WE for feedforward control, you may link this signal to parameters. Optionally, the binary input can be used to influence the actual value. Finally, you may define an operating point in manual mode, which is then added to the calculated operating point in automatic mode.

3.4.1 C.PID Dynamic behavior of controller output

This function enables you to define a dynamic behavior for the compact controller according to the control algorithm. Factory default is PI action. You can also set the control parameters. Moreover, you may define the dead band DZXD for the error; the control signal does not change within this band. In addition, you can determine limits for the error using the parameters $\underline{\vee}$ DZXD and $\overline{\wedge}$ DZXD. These minimum or maximum values of error are used for output signal calculation.

Choose between:

- P — P controller
- PI — PI controller
- PD — PD controller
- PID — PID controller
- PPI — P^{2}I controller

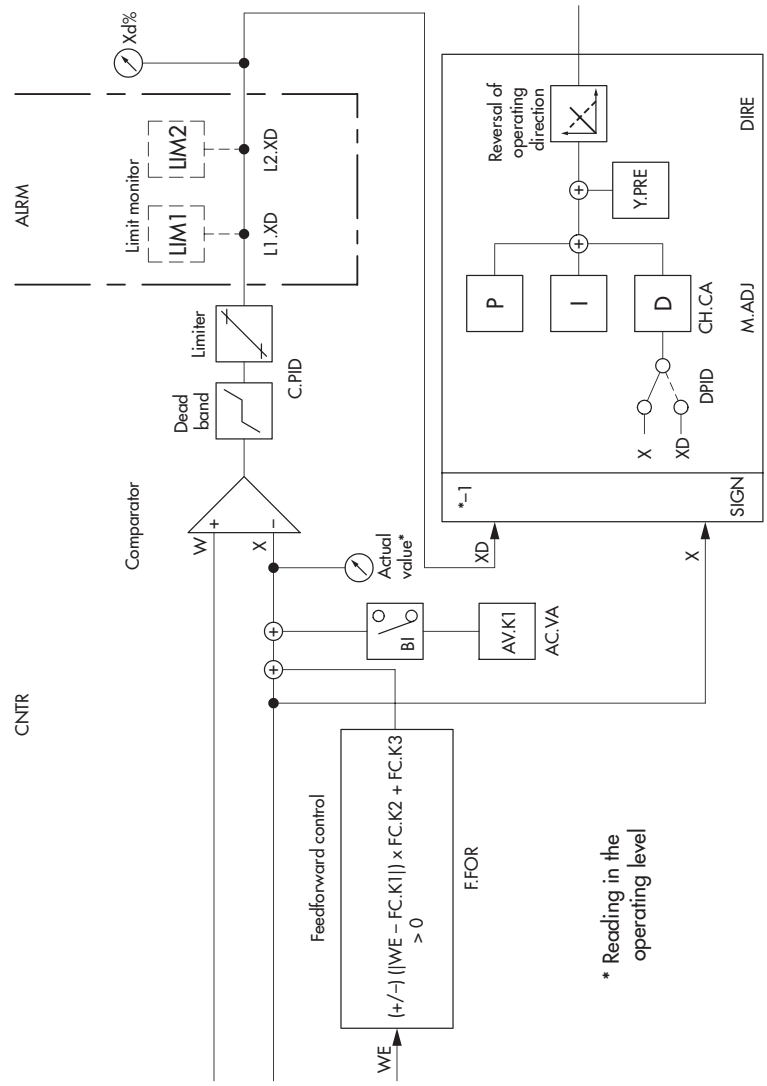


Fig. 6 · Main group CNTR

Parameters to be set

KP	Proportional-action coefficient
TN	Reset time
TV	Derivative-action time
TVK1	Derivative-action gain
Y.PRE	Y rate action
DZXD	Dead band of error
⊻ DZXD	Limitation of error, lower limit
⊼ DZXD	Limitation of error, upper limit

3.4.2 SIGN Inversion of error Xd

This function enables you to reverse the input operating direction. Multiplication by –1 converts an increasing error into a decreasing one, or vice versa, a decreasing error into an increasing one. This also inverts the operating direction of the output signal. Note the set operating direction in the DIRE function (see section 3.4.6)! There, the operating direction of the output signals may be changed as well.

Choose between:

- dir.d No inversion of error
- in.d Inversion of error

3.4.3 D.PID Assignment of controller output D element

When dynamic behavior with D component has been selected (see section 3.4.1), you may set different input variables for the D element: error or controlled variable.

If you have selected error, the compact controller reacts to a fast change in the controlled variable, the reference variable or the disturbance variable by generating a D-step response.

If you select the controlled variable, only a fast change in the controlled variable causes a D-step response in the output variable. The D component of the compact controller does not consider changes in the disturbance or the reference variable.

Choose between:

- F01 DP.YP Assignment of controller output D element to error
- F02 DP.YP Assignment of controller output D element to controlled variable

3.4.4 CH.CA Control mode changeover P(D)/PI(D) control

Control mode changeover enables the compact controller to be operated under varying operating conditions with different dynamic behaviors according to the control algorithm. Generally, control mode changeover is only useful when a control action with I component has been selected (see section 3.4.1).

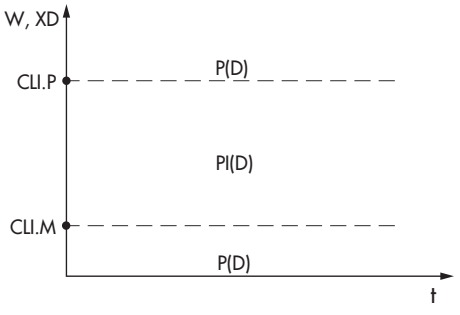


Fig. 7 · Control mode changeover

The control mode changeover function activates either P (or PD) or PI (or PID) control depending on the error or reference variable.

Beyond the definable range of the reference variable or error, the parameters for P or PD control are used to operate the controller. Within this definable range, the I component is included. The range is defined by the parameters CLI.P and CLI.M, as illustrated in Fig. 7.

Special feature of F01 CC.P setting:

If the controller changes from manual to automatic mode while the error is outside the defined range, the operating point is determined by the last manual output value. The operating point applies until the error returns to the range. The operating point of PI(D) action is determined there. If the error moves outside the range again, the last output value is set as the operating point. If the controller changes from automatic to manual mode, the operating point required for the plant must be reset again before returning to the automatic mode. The operating point is only saved temporarily (Y.PRE parameter does not have any effect). After power failure, the operating point must be reset in manual mode.

Choose between:

- oFF CC.P — No control mode changeover
- F01 CC.P — Control mode changeover activated by error
- F02 CC.P — Control mode changeover activated by reference variable

Parameters to be set

CLI.P Maximum limit for range of PI(D) control
CLI.M Minimum limit for range of PI(D) control

3.4.5 M.ADJ Operating point adjustment in manual mode for Y_{PID}

This function enables you to activate operating point adjustment in manual mode. In the factory defaults, this option is deactivated. To activate the operating point adjustment proceed as follows: in manual mode, adjust the output variable using the cursor keys to the desired value. When switching to automatic mode, the last value received is stored as operating point and added to the output variable calculated by the P or PD algorithm. The stored operating point remains effective until the operating point adjustment in manual mode is deactivated by selecting oFF MA.YP, or until a new operating point is adjusted in manual mode.
If you deactivate operating point adjustment in manual mode, the output variable specified in manual mode will assume the calculated value within approx. two seconds.

Choose between:

- oFF MA.YP — Operating point adjustment in manual mode for Y_{PID} deactivated
- on MA.YP — Operating point adjustment in manual mode for Y_{PID} activated

3.4.6 DIRE Operating direction of output variable

The output variable may either act directly or inversely to the error. This operating direction is defined with the DIRE function. Note that the operating direction can also be inverted with the SIGN function (see section 3.4.2).

Choose between:

- dir.d DI.AC — Direct operating direction of output variable (factory default)
- in.d DI.AC — Inverted operating direction of output variable

3.4.7 F.FOR Feedforward control

You may use the input WE for feedforward control (see section 3.3.1). The disturbance signal can be multiplied and additively linked by parameters according to the formula:
± (WE – FC.K1) FC.K2 + FC.K3. The following then applies: (WE – FC.K1) ≥ 0.

The signal is then connected to the controlled variable. FC.K1, FC.K2 and FC.K3 are constants you have to define in parameter level. The mathematical sign of the formula stated above is determined in the F.FOR function.

Choose between:

- oFF FECO — Feedforward control deactivated (factory default)
- POS FECO — Feedforward control with positive sign
- nE6 FECO — Feedforward control with negative sign

Parameters to be set

FC.K1 Constant for formula stated above
FC.K2 Constant for formula stated above
FC.K3 Constant for formula stated above

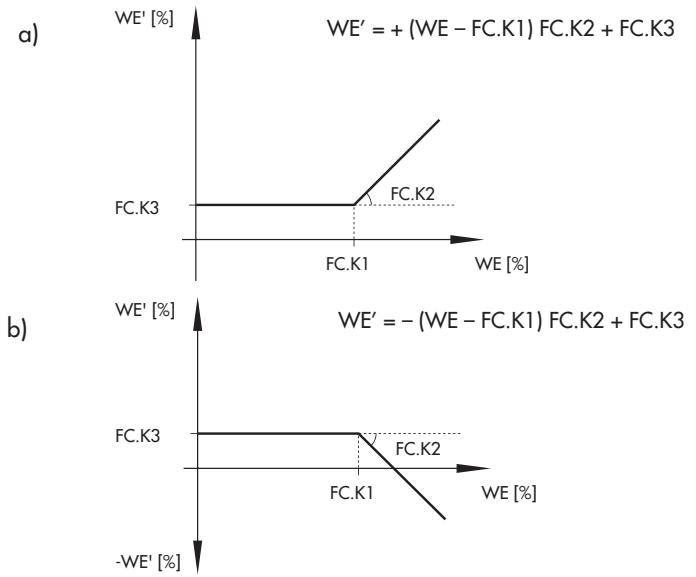


Fig. 9 · Feedforward control with positive (a) and negative (b) signs

3.4.8 AC.VA Increase, decrease of actual value

This function enables you to increase or decrease the actual value.
Upon activation of the binary input, the input signal X is additively linked to the parameter AV.K1. The new actual value is now used for control. It is also indicated in the upper display section for the controlled variable. Upon deactivation of the binary input, the input signal X is used for control again. In parameter level, the parameter AV.K1 is given in percent ranging from –110 to 110 %. When entering, for example, AV.K1 = 30 %, the current value for X will be increased from 50 to 80 %.

Choose between:

- oFF IN.DE Increase, decrease of actual value deactivated
- bi1 IN.DE Increase, decrease of actual value via binary input BI1

Parameter to be set

AV.K1 Constant in %

Note! *Several functions can be assigned to the binary input!*

3.5 Output functions

This main group enables you to define the output functions of the compact controller. You may specify whether the compact controller operates with continuous-action or switching output. The output signal can be limited and ramps can be defined. You can also output X, WE or XD to the continuous output and transfer them to a recorder. In addition, mathematical adaptations can be made for the continuous-action output. The switching outputs can be used as binary outputs to signalize varying operating conditions. The following functions can be assigned to the binary input in this main group: locking of the output signal, manual/automatic changeover, starting an output ramp or initializing the second output variable Y1K1.

3.5.1 SAFE Initialization of constant output value Y1K1 for Y_{PID}

This function enables you to give out a predefined value for the output variable at the controller output if the binary input has been activated. This output value is the parameter Y1K1. It is adjusted in percent in parameter level.

oFF SA.VA	Deactivated
bi1 SA.VA	Initializing Y1K1 via binary input BI1

Parameter to be set

Y1K1 Constant output value in %

Note! *Several functions can be assigned to the binary input!*

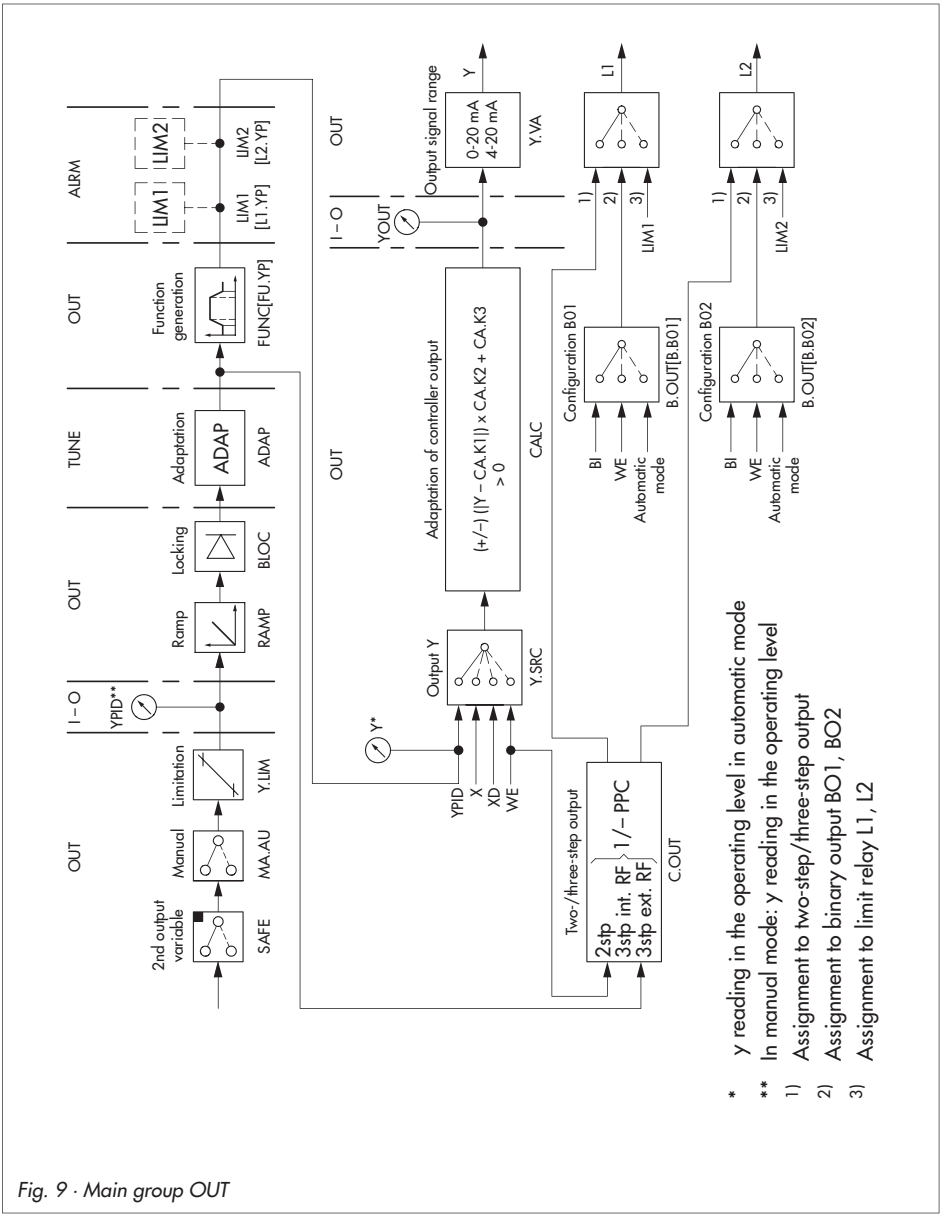
3.5.2 MA.AU Manual/automatic changeover

When choosing the bi1 settings in this function, the controller switches to manual mode upon activation of the binary input and locks the manual/automatic key. When the binary input is deactivated, the controller switches back to automatic mode. Exception: if the controller was in manual mode upon activation of the binary input already, it remains in manual mode. Manual mode is indicated by the ✋ on the display.

Choose between:

oFF CH.MA	Function deactivated
bi1 CH.MA	Transfer to manual mode via binary input BI1

Note! *Several functions can be assigned to the binary input!*



* y reading in the operating level in automatic mode
** In manual mode: y reading in the operating level
1) Assignment to two-step/three-step output
2) Assignment to binary output BO1, BO2
3) Assignment to limit relay L1, L2

Fig. 9 · Main group OUT

3.5.3 Y.LIM Output signal limitation Y_{PID}

Output signal limitation is always active. When entering parameter level, only the minimum and maximum output variable may be set.

on LI.YP Output signal limitation Y_{PID} activated

Parameters to be set

$\underline{Y}$ Minimum output variable

$\overline{Y}$ Maximum output variable

3.5.4 RAMP Output ramp or limitation of rate of output changes Y_{PID}

This function enables you to implement an output ramp or limit the rate of output changes. The rate of output changes can be limited for an increasing and/or a decreasing output signal. Output ramp means that the output variable changes at a constant speed. The parameter TSRA determines the transit time of the output variable ramp and, thus, the speed. TSRA refers to an output change of 100 % (see Fig. 10).

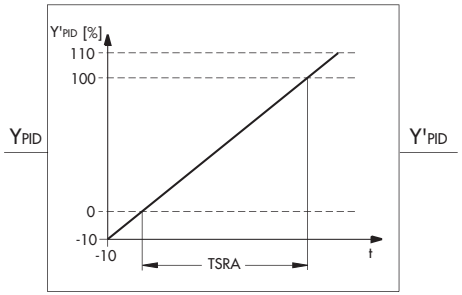


Fig. 10 · Output ramp

The output ramp is started by activating the binary input bi1. You may choose between starting the ramp with either –10 % or with the value of the parameter Y1RA. The ramp is deactivated in manual mode and upon restart after a power failure.

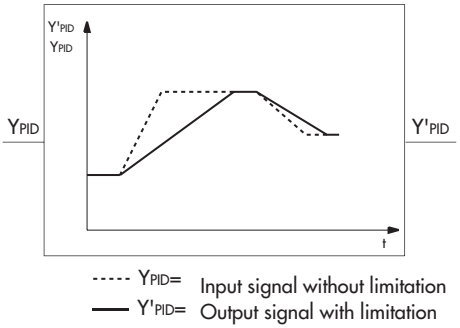


Fig. 11 · Limitation of rate of output changes

The rate of output changes can be limited for a decreasing and an increasing output variable (F03 RA.YP), for an increasing output variable (F04 RA.YP), or for a decreasing output variable (F05 RA.YP). In the limited direction(s), the output variable changes only as fast as the parameter TSRA allows it to. If the rate of output changes is slower than the defined rate of changes, limitation will not be effective. Fig. 11 illustrates the effect of the described function.

The rate of changes for the output variable v_y is calculated as follows:

$$v_y = \frac{100\ \%}{TSRA}$$

Choose between:

oFF RA.YP	Deactivated
F01 RA.YP	Ramp when BI1 activated, starts with –10%,
F02 RA.YP	Ramp when BI1 activated, starts with parameter Y1RA
F03 RA.YP	Limitation for decreasing and increasing output variable
F04 RA.YP	Limitation for increasing output variable
F05 RA.YP	Limitation for decreasing output variable

Parameters to be set

TSRA	Transit time of output ramp
Y1RA	Starting value for output ramp

Note!
Several functions can be assigned to the binary input!

3.5.5 BLOC Locking of output signal Y_{PID}

This function locks the output signal upon activation of the binary input BI1. As a result, the current value of the output variable at the controller output remains unchanged as long as the binary input is active. When it is deactivated, the locking of the output signal will be canceled, and the controller continues to work with the last output value calculated.

Choose between:

- oFF BL.YP — No locking of output signal via binary input (factory default)
- bi1 BL.YP — Locking of output signal via binary input BI1

Note!
Several functions can be assigned to the binary output!

3.5.6 FUNC Function generation of output variable

Functions may be generated of the output variable as well as of the input variables X and WE. We do not go into any further details here, as function generation is dealt with in section 3.2.8. However, make sure to enter the pairs of values in percent. The parameters MIN and MAX are preset (–10 and 110 %) and cannot be changed.

Choose between:

- oFF FU.YP — No function generation of output variable
- on FU.YP — Function generation of output variable

Parameters to be set

K1.X to K7.X Input values for points 1 to 7 in %
K1.Y to K7.Y Output values for points 1 to 7 in %

3.5.7 Y.VA Output signal range

This function enables you to define the range of the continuous-action output:

- oFF Y — No continuous-action output
- 0-20 mA — 0-20 mA output
- 4-20 mA — 4-20 mA output

3.5.8 Y.SRC Assignment of continuous-action output

This function enables you to determine whether the continuous-action output is used as controller output (PID output) or assigned to the inputs X or WE, or to error. Optionally, the signals can then be transferred to a recorder.

The Y.XD setting allows the error XD in the range 0 to 100 % to be issued at the output.
If the range –100 to 100 % is to be issued at the output, the CALC mathematical adaption must be activated (on CA.Y) and the parameters must be set as follows:
CA.K1 = 100.0, CA.K2 = 0.5, CA.K3 = 100.0

- on Y.PID Assignment to PID output
- on Y.X ~ to X input
- on Y.WE ~ to WE input for feedforward control
- on Y.XD ~ to error Xd

3.5.9 CALC Mathematical adaption of continuous output

This function enables you to mathematically modify the continuous-action output to set it up for a recorder, for example. The following formula applies:

$$YOUT = \pm(Y - CA.K1)\ CA.K2 + CA.K3$$

- oFF CA.Y Mathematical adaptation deactivated (**Note!** No output signal!)
- POS CA.Y Mathematical adaptation with positive sign
  + (Y – CA.K1) CA.K2 + CA.K3. Whereby, (Y – CA.K1) ≥ 0 applies
- nE6 CA.Y Mathematical adaptation with negative sign
  – (Y – CA.K1) CA.K2 + CA.K3. Whereby, (Y – CA.K1) ≥ 0 applies
- on CA.Y Mathematical adaptation without condition
  (Y – CA.K1) CA.K2 + CA.K3.

Parameters to be set

CA.K1 Constant for formula given above in %
CA.K2 Constant for formula given above (for continuous output, adjust > 0!)
CA.K3 Constant for formula given above in %

3.5.10C.OUT Configuration of two-step or three-step output

This function enables you to select a two-step or three-step output. The active two-step output is easily identified by the + icon. For the three-step output, the + icon indicates an active Y+ output, whereas the − icon indicates an active Y– output.

Note!
Selecting one of these settings has priority over the settings in the B.OUT functions (see section 3.5.11, as well as over LIM1 and LIM2 (see section 3.6).
When configuring a three-step output, the functions of the binary outputs or limit relays cannot be used! When configuring a two-step output, you may use the functions of the binary output BO2 or the limit relay L2.

Choose between:

oFF 2/3S.	No two-step or three-step output
on 2.STP	Two-step output
i.Fb 3.STP	Three-step output with internal position feedback
E.Fb 3.STP	Three-step output with external position feedback
PP 2.STP	Two-step output with pulse-pause modulation (PPM)
i.PP 3.STP	Three-step output with internal position feedback and PPM
E.PP 3.STP	Three-step output with external position feedback and PPM

When accessing the parameter level, all parameters available for output configuration are displayed. On the following pages, we will explain which parameters are relevant for which output, so that you only need to define the ones you require.

Note!
On switching over from automatic to manual mode, the relays of the two-step and three-step outputs are deactivated
In manual mode and with the Y reading at the bottom of the display, the relay outputs can be activated using the ▽ and △ keys.

Two-step output

The two-step output can only assume two states: on (1) or off (0). This controller output is used for applications, such as electric radiators with thermostat behavior.

This version of the two-step output corresponds with a monitoring of the limit value violation by the Y_{PID}.

The parameters dead band TZ and XSDY determine the switch-on and switch-off point of the two-step output. The parameter XSDY represents the differential gap and is used to prevent the two-step output from constantly switching on and off upon small deviations.

The electrical wiring is the same as for the binary output BO1 (see section 7).

The two-step output with pulse-pause modulation (PPM) is described on page 45.

Parameters to be set

XSDY Differential gap (e.g. 0.2...2 %)
TZ Dead band = Switching point (0.1...100.0 %)

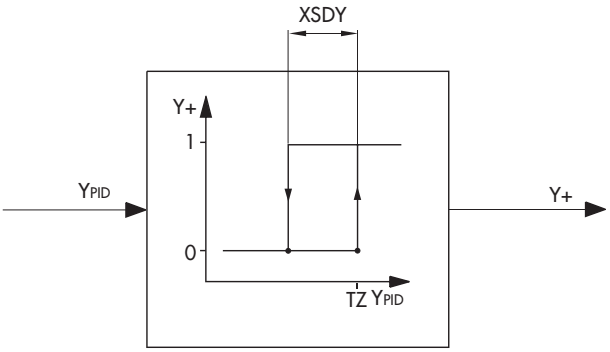


Fig. 12 · Two-step output

Three-step output with internal position feedback

For the three-step output with internal position feedback, the position of a valve is determined by the transit time of the connected actuator. This transit time needs to be specified as parameter TY.

The output variable of the three-step output can assume three values: –100 %, 0 and 100 %. This controller output is used, e.g. for electric actuators, the three output variables corresponding to "counterclockwise rotation", "motor switched off" or "clockwise rotation". A definable dead band lies between both switching points. The dead band is the parameter TZ (see Fig. 12). In addition, you have to specify the parameter XSDY, which represents the differential gap. The differential gap applies to both switching points. Note that the differential gap must always be

smaller than $\frac{TZ}{2}$.

A comparator produces the difference between the Y_{PID} signal and the feedback signal Y_R. This difference constitutes the output value for the three-step output. The following applies:

When the difference is greater than $\frac{TZ}{2}$ and larger than 0, the Y+ output is activated.

When the differential gap is greater than $\frac{TZ}{2}$ and smaller than 0, the Y– output is activated.

When the difference is smaller than $\frac{TZ}{2}$ – XSDY, the three-step output is deactivated.

When the Y_{PID} value exceeds 105 % or falls below –5 %, a permanent signal is issued at the controller output.

Parameters to be set

XSDY	Differential gap in % (e.g. 0.5 %)
TZ	Dead band of three-step output (e.g. 2.0 %)
TY	Transit time of actuator in seconds

Three-step output with external position feedback

This type of three-step output feeds back the position of a connected actuator externally via the WE input using, for example, a potentiometer. Apart from that, this three-step output is similar to the three-step output with internal position feedback.

When a potentiometer is used for external position feedback, it needs to be calibrated as described in section 3.9.5.

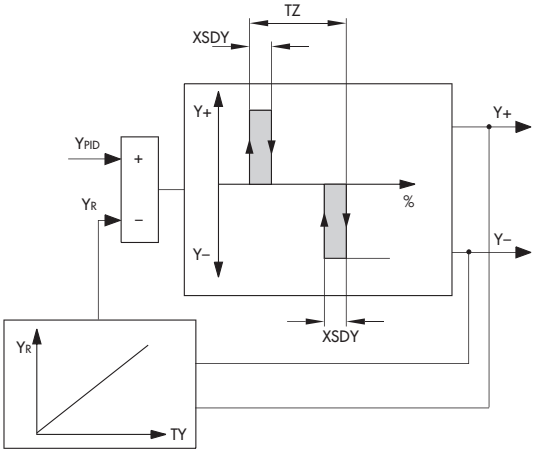


Fig. 13 · Three-step output with internal position feedback

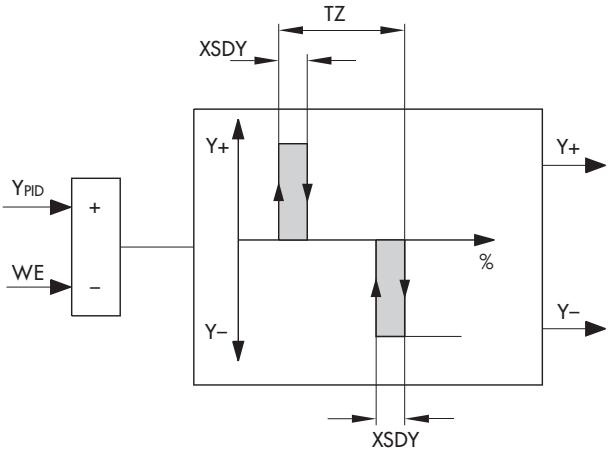


Fig. 14 · Three-step output with external position feedback

Parameters to be set

XSDY Differential gap of two-step/three-step output in %
TZ Dead band of three-step output in %

Two-step output with pulse-pause modulation (PPM)

The two-step output with pulse-pause modulation (PPM) converts the continuous Y_{PID} signal into a pulse sequence whose pulse-pause ratio varies depending on the Y_{PID} value (see Fig. 15).

The on-time T_E of the two-step signal Y+ results from:

$$T_E = \frac{\left(Y\,[\%] - TZ\,[\%] \cdot KPL1\right)}{100\,[\%]} \cdot TYL1\ [s]$$

The parameter TYL1 is the duty cycle and the maximum on-time at the same time. KPL1 is a gain factor.

In addition, you need to set the parameter ⩔ TYL1. It specifies the minimum on-time in percent of the duty cycle. Due to the hardware, the minimum on-time is at least 0.3 s.

When choosing the parameters TYL1, KPL1 and ⩔ TYL1 suitably, the two-step output with PPM provides a good compromise between small fluctuations in the controlled variable (high switching frequency) and high service life of the final control element (low switching frequency). The eletrical wiring is the same as for binary output BO1 (see section 7). The two-step output with adjustable hysteresis is described on page 42.

Parameters to be set

KPL1 Gain Y+
TYL1 Duty cycle, maximum on-time in seconds
⩔ TYL1 Minimum on-time of Y+ in %
TZ Dead band of two-step output in %

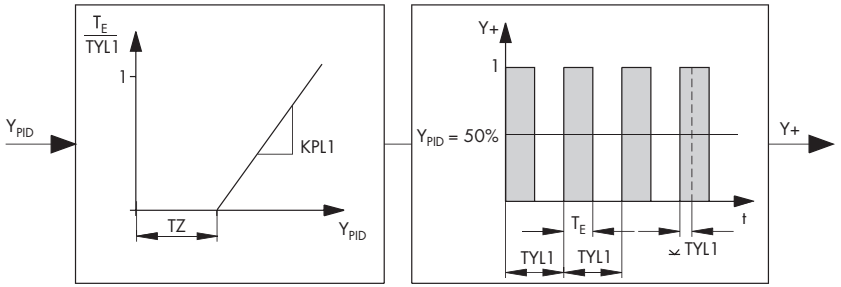


Fig. 15 · Two-step output with PPM

Three-step output with internal position feedback and PPM

The three-step output with internal position feedback and pulse-pause modulation converts the three-step signal into a pulse sequence.

The characteristic of this output is illustrated in Fig. 16. The position of the control valve is determined by the transit time of the connected actuator. You can specify the transit time via the parameter TY. The difference created from the Y_{PID} signal and the feedback signal Y_{PID} is converted into a pulse sequence depending on the defined duty cycle. The duty cycle can be defined individually for the Y+ signal as well as the Y– signal. The parameter TYL1 determines the duty cycle for the Y+ signal, and the parameter TYL2 for the Y– signal. In addition, you have to specify the minimum on-time in percent of the duty cycle via the parameter ⧗ TYL1 for the Y+ signal, and via ⧗ TYL2 for the Y– signal. Due to the hardware, the minimum on-time is at least 0.3 s.

The dead band also needs to be defined via the parameter TZ. The dead band must be specified in percent referred to the difference Y_{PID}– WE. If necessary, the parameters KPL1 and KPL2 providing a certain gain can be changed as well. You can use them together with the parameters TYL1 and TYL2 to adapt the connected actuator to different opening and closing times.

Parameters to be set

KPL1	Gain Y+
KPL2	Gain Y–
TYL1	Duty cycle Y+ in s
TYL2	Duty cycle Y– in s
⧗ TYL1	Minimum on-time Y+ in s
⧗ TYL2	Minimum on-time Y– in s
TZ	Dead band of three-step output in %
TY	Transit time of actuator in s

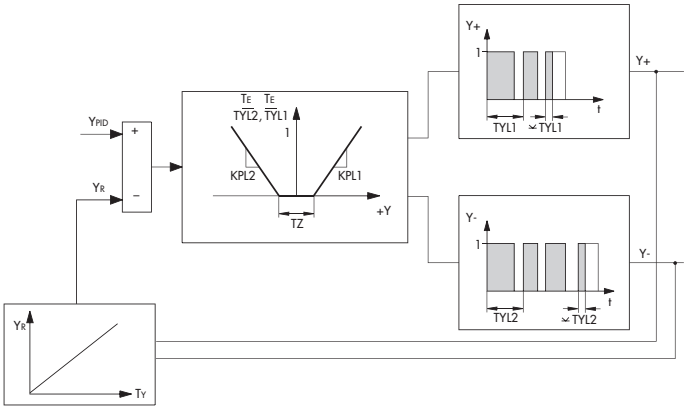


Fig. 16 · Three-step output with internal position feedback and PPM

Three-step output with external position feedback and PPM

This type of three-step output is similar to the three-step output with internal position feedback and pulse-pause modulation (PPM). The only difference is that the position of a connected actuator is fed back externally via the WE input, for example using a potentiometer. The parameter TY is omitted. The assignment of the WE input for the external position feedback is performed in the main group SETP (function SP.VA, setting F01 WE). Refer to section 3.3.1. If a potentiometer is used for external position feedback, it must be calibrated as described in section 3.9.5.

Parameters to be set

KPL1	Gain Y+
KPL2	Gain Y–
TYL1	Duty cycle Y+ in s
TYL2	Duty cycle Y– in s
⩤ TYL1	Minimum on-time Y+ in s
⩤ TYL2	Minimum on-time Y– in s
TZ	Dead band of three-step output in %

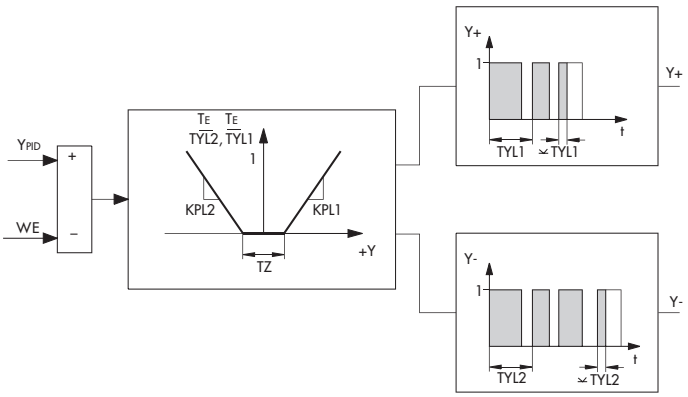


Fig. 17 · Three-step output with external position feedback and PPM

3.5.11B.OUT Configuration of binary outputs BO1 and BO2

This function enables you to specify which operating conditions are to be indicated by the binary outputs BO1 and BO2. You can view the states of the binary outputs in the I-O level with the BIN function (see section 3.9.4).

Note!
When you have selected a three-step output (see section 3.5.10), you are not able to use the functions of the binary outputs. Having selected a two-step output, you can use the functions of the binary output BO2. All the settings of B.OUT have priority over the settings made with the functions LIM1 and LIM2 (see section 3.6.1).

Choose between:

Configuration of binary output BO1

oFF B.BO1	Binary output BO1 deactivated
F01 B.BO1	Active when binary input active
F02 B.BO1	Active when external reference variable selected
F03 B.BO1	Active in automatic mode

Configuration of binary output BO2

oFF B.BO2	Binary output BO1 deactivated
F01 B.BO2	Active when binary input active
F02 B.BO2	Active when external reference variable selected
F03 B.BO2	Active in automatic mode

3.6 ALRM Alarm functions

This main group enables you to determine the functions of the limit relays L1 and L2.

The limit relays monitor variables as to whether they exceed or fall below a limit value. The limit relay can assume two switching states. When the switching condition is fulfilled, the limit relay is closed, if not it is open.

The functions LIM1and LIM2 determine which variable will be monitored by the limit relay L1 or L2, and also whether the limit relay becomes active when limit values are exceeded or not reached.

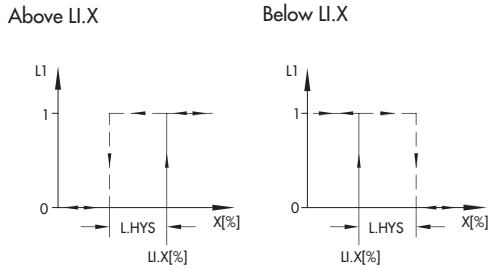


Fig. 18 · Function of the limit relays L1 and L2

The limit value of the selected variable is defined in parameter level via LI.X, LI.WE, LI.YPID or LI.XD. In addition, you have to set the parameter L.HYS to define a differential gap (hysteresis). The differential gap is the distance between the points where the limit relay switches on and off.

It is given in percent referred to the measuring range.

Fig. 18 illustrates the function of the limit relay, exemplifying the monitoring of the controlled variable X with the associated parameters.

First case: the limit relay monitors the controlled variable for exceeding a preset limit. The limit relay is activated when the controlled variable X increases and reaches the preset limit LI.X, LI.WE, LI.YPID or LI.XD. When the controlled variable decreases and reaches the preset limit minus the differential gap L.HYS, the limit relay is deactivated.

Note that LI.X and LI.WE are stated in absolute values. However, in Fig. 18, LI.X is given in percent!

Second case: the limit relay monitors the controlled variable X for falling below a preset limit. The limit relay is activated when the controlled variable decreases and reaches the preset limit LI.X, LI.WE, LI.YPID or LI.XD. When the controlled variable increases and reaches the limit LI.X plus the differential gap L.HYS, the limit relay is deactivated.

When limit relay 1 is activated, the L1 icon appears on the display. The L2 icon is displayed when limit relay 2 is activated.

3.6.1 LIM1 Limit relay L1

The function of the limit relays has been described in the previous section 3.6.

Note!
Functions of the two-step or three-step output C.OUT (see section 3.5.10) and functions of the binary outputs B.OUT (see section 3.5.11) have priority over the settings of the functions LIM1 and LIM2.

Choose between:

Limit relay L1

☐	oFF L1	Limit relay L1 deactivated	
☐	Lo L1.X	~	L1 activated when LI.X is not reached
☐	Hi L1.X	~	L1 activated when LI.X is exceeded
☐	Lo L1.WE	~	L1 activated when LI.WE is not reached
☐	Hi L1.WE	~	L1 activated when LI.WE is exceeded
☐	Lo L1.YP	~	L1 activated when LI.YP is not reached
☐	Hi L1.YP	~	L1 activated when LI.YP is exceeded
☐	Lo L1.XD	~	L1 activated when LI.XD is not reached
☐	Hi L1.XD	~	L1 activated when LI.XD is exceeded
☐	AbS L1.XD	~	L1 activated when the value of LI.XD is exceeded

Parameters to be set

LI.X	Limit for X, as absolute value
LI.WE	Limit for WE, as absolute value
LI.YP	Limit for Y_{PID} in %
LI.XD	Limit for XD in %
L.HYS	Differential gap in % based on measuring range

3.6.2 LIM2 Limit relay L2

This function enables you to define the functions of limit relay L2, described in section 3.6.

Note!
Functions of the two-step or three-step output C.OUT (see section 3.5.10) and functions of the binary outputs B.OUT (see section 3.5.11) have priority over the settings of the functions LIM1 and LIM2.

Choose between:

Limit relay L2

- oFF L2 Limit relay L2 deactivated
- Lo L2.X ~ L2 activated when X is not reached
- Hi L2.X ~ L2 activated when X is exceeded
- Lo L2.WE ~ L2 activated when WE is not reached
- Hi L2.WE ~ L2 activated when WE is exceeded
- Lo L2.YP ~ L2 activated when Y_{PID} is not reached
- Hi L2.YP ~ L2 activated when Y_{PID} is exceeded
- Lo L2.XD Limit relay L2 activated when XD is not reached
- Hi L2.XD ~ L2 activated when XD is exceeded
- AbS L2.XD ~ L2 activated when the value of XD is exceeded

Parameters to be set

LI.X Limit for X as absolute value
LI.WE Limit for WE as absolute value
LI.YP Limit for Y_{PID} in %
LI.XD Limit for X in %
L.HYS Differential gap in % based on measuring range

3.7 AUX Additional functions

This main group enables you to determine the restart conditions after a power failure has occurred. You may reset functions, parameters and calibrating values to factory defaults, and lock the operator keys. In addition, you may modify the contrast settings of the display.

3.7.1 RE.CO Restart conditions after power failure

This function enables you to define the output variable and operating mode after a power failure has occurred. Selection of F03 must be confirmed to return to normal control operation. In this case, the display sections for reference variable and controlled variable blink until the reset key is pressed.

Choose between:

- F01 MODE Manual mode with constant output value Y1K1
- F02 MODE Automatic mode with last reference variable value received and Y1K1, without confirmation
- F03 MODE Automatic mode with last reference variable value received and Y1K1, restart with confirmation via reset key

3.7.2 ST.IN Resetting to factory defaults

This function enables you to reset all settings for parameters, functions and calibrating values together or individually:

- FrEE INIT — Resetting deactivated/completed
- All INIT — Resetting all the functions, parameters and the key number
- FUnC INIT — Resetting all the functions
- PArA INIT — Resetting all the parameters and the key number
- AdJ INIT — Basic initialization of the calibrating values for In1, In2 and Y1

To reset to factory default, proceed as follows:

You are in the main group AUX and have selected ST.IN.

1. Press the enter key. FrEE INIT appears on the display.
2. Use the cursor keys to select from the above listed settings (All, FUnC,PArA or AdJ).
3. Press the enter key. Selected settings are reset to factory defaults. When resetting is completed, FrEE INIT is displayed again.

3.7.3 KEYL Operator keys

This function enables you to switch the function of the six keys via the binary input on and off, or to disable the selector key, the manual/automatic key or the cursor keys.

- oFF LOCK — Operator keys enabled
- bi1 LOCK — Enable/disable all keys via the binary input BI1
- on noH.W — Selector key, manual/automatic key and cursor keys disabled. The compact controller remains in the operating mode effective before you activated this function.

Note! *Several functions can be assigned to the binary input!*

3.7.4 VIEW Setting of display contrast

This function enables you to modify the display contrast from grade 1 to 10. This allows optimum display illumination at the site of installation. 1 is especially suitable for installation on high places, whereas 10 suits low places of installation.

Choose between:

- 1 VIEW Contrast setting 1
  to
- 10VIEW Contrast setting 10

3.7.5 FREQ Power frequency

This function enables you to set the power frequency of the system to either 50 or 60 Hz.

Choose between:

- on 50Hz Power frequency set to 50 Hz
- on 60Hz Power frequency set to 60 Hz

3.7.6 DP Decimal place setting

This function enables you to determine the number of decimal places for all variables directly related to the analog inputs In1 and In2.

Choose between:

- on DP0 No decimal place
- on DP1 One decimal place (factory default)
- on DP2 Two decimal places

3.8 TUNE Start-up adaption

This main group enables you to initiate a start-up adaptation. It works according to the inflectional tangent principle, which means that one unit step response is used to determine the inflectional point, the inflectional tangent as well as different characteristics.

The parameters K_P, T_N and T_V are calculated according to the rules for the aperiodic control operation and a reference variable changeover introduced by Chien, Hrones and Reswick.

For start-up adaptation, observe the following:

- The controlled system must be stable. Eliminate disturbance variables (e.g. drifting).
- The controlled system must be settled when beginning start-up adaption.
- Only adapt controlled systems with self-regulation.
- Adaption must be completed after 5 hours.

Note! *An adaption can only be performed with the analog control signal Y.*

3.8.1 ADAP Start-up adaption

The start-up adaption is started when you select run ADP.S. The parameter Y.JMP needs to be set before you start. Its value is added to the output variable to determine the step response of the controlled system. The step response can take place in both directions. It should be as large as possible and located around the operating point, however, without leaving the defined controlled variable range. If this should happen during adaptation, the process is interrupted and Err 32 is displayed.

When start-up adaption has been successfully completed, the determined parameters become effective immediately. The compact controller is in manual mode. Now switch to automatic mode.

Choose between:

- oFF ADP.S No adaption
- run ADP.S Launch start-up adaption

Parameter to be set

Y.JMP Value of step response in %

To run start-up adaption, proceed as follows:

The compact controller is in the operating level.

Press	Display shows	Comments
▢	PAR	You have accessed setup level.
▽ 2x	TUNE	You have reached the main group TUNE.
▢	-CO- ADAP	You have reached the function for start-up adaption.
▢	oFF ADP.S	Start-up adaption is not yet activated.
↵	PA ADAP (blinks)	Enter parameter level first in order to define the value for the step response.
▢	1.0 (factory default) KP	KP, TN, TV are the same as in C.PID.
▽	20.0 (factory default) Y.JMP	Parameter for the value of the step response.
▢	- - - - KEY	Prompted for key number, if applicable. If so, proceed as described on p. 10.
△ or ▽	(display blinks)	Adjust the value of the step response.
▢		Confirm value of the step response. The display stops blinking.

Press	Display shows	Comments
↵	oFF ADP.S	You are leaving the parameter level.
	oFF (blinks) ADP.S	
△	run (blinks) ADP.S	
	20 (blinks) ADP.S	Adaption is started. In sequence, status messages indicating the progress of the adaption are displayed in the upper section.
	End ADP.S	You have successfully completed start-up adaption.

Canceling start-up adaption

Press	Display shows	Comments
	StoP ADP.S	You may cancel adaption at any time to modify the parameters. Press the enter key again to restart adaption.

Errors during start-up adaption

The following errors may appear in the display. In addition, the binary output is set for alarm messages.

Display shows	Type of error	Comments
30 ERR	Timeout > 5 h	Adaptation is terminated after 5 hours.
31 ERR	Impossible to determine parameters	Adaptation cannot determine any parameters.
32 ERR	X input < 0 % or > 100 %	Modify Y.JMP.

33 ERR	Interferences too strong	Increase Y.JMP and check interferences.
34 ERR	Selected PID setting does not allow adaption	Set P, PI or PID control in the C.PID function (main group CNTR).
35 ERR	Control signal in limit	Modify Y.JMP.
36 ERR	Disturbance	Restart adaption.

3.9 I-O View process data

This main group enables you to view different variables and data. In addition, you may adjust zero and span for the analog inputs IN1 and IN2 as well as the analog output Y.

3.9.1 CIN Firmware

This menu indicates the firmware (software) version you are using.

- FIR View firmware version

3.9.2 S-No Serial number

This menu indicates the serial number of your controller. All controllers are assigned a unique serial number by the manufacturer.

- View serial number

3.9.3 ANA View values of analog inputs

This menu enables you to view the values of analog variables. Also note Fig. 2 on page 19, Fig. 4 on page 26, Fig. 6 on page 30, and Fig. 9 on page 36. There you will find the displayed variables illustrated.

- IN1 Analog input 1 (absolute value)
- IN2 Analog input 2 (absolute value)
- CO.VA Controlled variable before function generation has been performed
- WE.VA Reference variable before function generation has been performed
- FE.CO WE prior to applying feedforward control (when using WE for feedforward control, i.e. parameter SP.VA set to F02 WE in the main group SETP, WE is not displayed in operating level).
- SP.CO Reference variable at the comparator
- YPID YPID after limitation
- YOUT Controller output after mathematical adaptation Y_{OUT}

3.9.4 BIN Status of binary input and outputs

This menu indicates the respective status of the binary input and outputs.

- BI1 Status of binary input BI1 on/oFF
- BO1 Status of binary output BO1 on/oFF
- BO2 Status of binary output BO2 on/oFF

3.9.5 ADJ Adjusting the analog inputs and output

This function enables you to adjust zero and span for the analog inputs and the analog output.

Proceed as follows:

You are in the main group I-O and have selected ADJ.

1. Press the enter key. ADJ IN1 is displayed.
2. Select the respective input or output using the cursor keys:
   AdJ IN1 Adjust analog input IN1
   AdJ IN2 Adjust analog input IN2
   AdJ Y1 Adjust analog output Y
3. Press the enter key.
4. You are prompted to enter the key number. Enter the key number via the cursor keys.
5. Confirm with the enter key.
6. Adjust the desired signal to the lower range value using a high-precision meter. In the adjustment section of the display, ZERO and IN1 (IN2 or Y1) are displayed alternately.
7. Press the enter key. Zero adjustment is completed. The display shows 0.0 and ZERO.
8. Adjust the desired signal to the upper range value using a high-precision meter. In the adjustment section of the display, SPAN and IN1 (IN2 or Y1) are displayed alternately.
9. Press the enter key. Span adjustment is completed. The display stops blinking and shows 100.0 and SPAN.
10. Press the return key once. Continue with step 2 if you wish to adjust additional inputs or the output. The key number does not need to be entered again.

4 Practical examples

In this section, we will show you how to configure your TROVIS 6493 Compact Controller to implement fixed set point control, follow-up control and follow-up control with function generation. We assume you know how to operate the controller. If not, read section 2. Note that there are two controller versions due to the different inputs In2!

4.1 Fixed set point control

For this example, we have chosen a simple temperature control loop as illustrated in Fig. 19. The controlled variable X represents the flow temperature, which is measured at the input IN2 via a Pt 100 sensor. The flow temperature is to be controlled to a fixed reference variable value. The TROVIS 6493-01 Compact Controller issues a continuous 4 to 20 mA signal as output variable Y. To perform this control task, you only need to define the reference variable and the control parameters. The reference variable can be set directly in operating level using the cursor keys. The control parameters, however, must be defined in setup level in the main group CNTR. All other required settings are configured in the compact controller by default. The table below lists the settings you require:

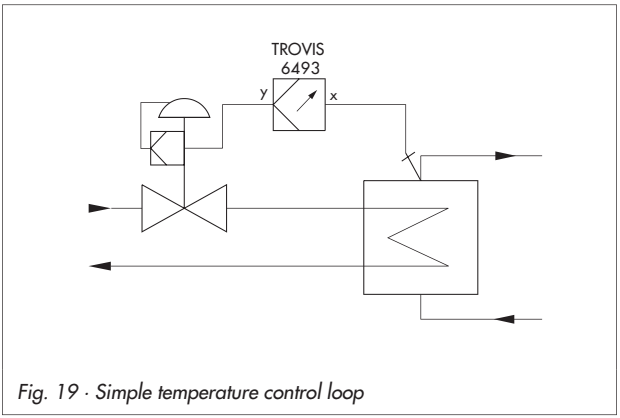


Fig. 19 · Simple temperature control loop

Setup level

Main group	Function -CO-	Setting	Parameter -PA-	Value	Comment
CNTR	-CO- C.PID	PI (factory default)	KP TN	0.8 16.0	Define control parameter
	-CO-DIRE	dir.d	–		Change operating direction, if necessary

Operating level

Use selector key to display W. Use cursor keys to adjust new value.	Determine new value for reference variable

4.2 Follow-up control

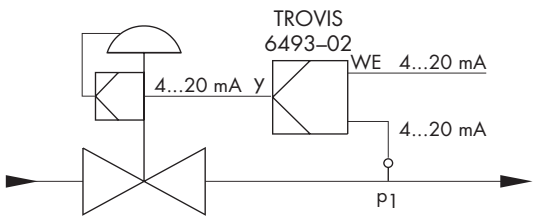


Fig. 20 · Pressure control

A follow-up control loop is illustrated in Fig. 20. In this example, a pressure between 0 and 10 bar is controlled and measured via a two-wire transmitter. The two-wire transmitter could be the SAMSOMATIC Type 3994-0050 Transmitter, for example. The external reference variable is provided by a 4 to 20 mA signal. In addition, we want to be able to switch to a fixed value for the internal reference variable. The control valve with positioner is controlled by a continuous output variable Y ranging from 4 to 20 mA. The controller version TROVIS 6493-02 with two mA inputs is used in this example.

Proceed as follows:

- The controlled variable X represents the pressure p_1, which is measured via a two-wire transmitter and connected to the input In2. This input is designed for 4 to 20 mA by default, i.e. it does not need to be changed. However, you have to set the measuring range for this input to 1 to 10 bar. To do this, select the -CO- IN2 function in the main group IN, and define the measuring range in the parameter level.
- The external reference variable WE is applied to the input In1 as a 4 to 20 mA signal. The input In1 is originally set up for 4 to 20 mA, therefore it does not need to be changed. However, you must determine the measuring range for the reference variable in parameter level with 0 to 10 bar. To do this, open the parameter level in the main group IN in the function -CO-IN1.

  By default, WE is deactivated. To activate WE, enter the -CO- SP.VA function in the main group SETP and select WE. Set WE to "on". Additionally, set the measuring range of W (internal reference variable) to 0 to 10 bar. In operating level, you may now select W or WE as reference variable. When defining WE as active reference variable, follow-up control is implemented automatically. When defining W as active reference variable, you have set up fixed set point control. For this control action, you can enter the reference variable value in operating level via the cursor keys.
- Control action should be PID, not PI as specified in factory defaults. Go to the main group CNTR, and change the settings of the -CO- C.PID function to PId. Additionally, alter KP, TN, and TV in the parameter level.

- By default, the output variable Y is set up for a continuous signal ranging from 4 to 20 mA. As a result, the output variable does not need to be modified in this example.

The following table lists the required settings in short, together with the parameter definitions:

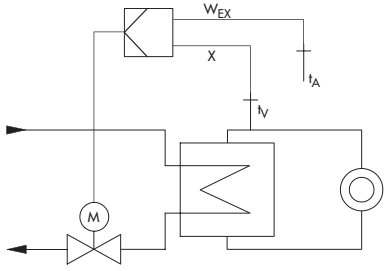
Setup level

Main group	Function -CO-		Setting	Parameter -PA-	Value	Comment
IN	-CO- IN1		4-20 mA (factory default)	⩡IN1 ⩠IN1	0 [bar] 10 [bar]	Define measuring range for input 1, WE assigned (factory default)
	-CO- IN2		4-20 mA	⩡IN2 ⩠IN2	0 [bar] 10 [bar]	Define measuring range for input 2, X assigned (factory default)
	-CO- CLAS	X	In2 (factory default)			Assign controlled variable X to input In2
		WE	In1 (factory default)			Assign reference variable to input In1
SETP	-CO- SP.VA	WE	on			Activate WE and follow-up control with it
		W	on (factory default)	W ⩡WINT ⩠WINT	5.2 [bar] 0 [bar] 10 [bar]	Value for internal variable W Measuring range for W
CNTR	-CO- C.PID		PId	KP TN TV TVK1	0.8 16.0 6.0 1.0	Select PID action and specify control parameters
	-CO- DIRE		dir.d	–		Change operating direction, if necessary.

Operating level

Press selector key to view WE. Press enter key.	Define WE as active reference variable

4.3 Follow-up control with function generation



tV Flow temperature tA Outdoor temperature

Fig. 21 · Temperature control with function generation

We will show you how to use function generation exemplifying an outdoor temperature-sensitive flow temperature control loop, as illustrated in Fig. 21.

The controlled variable represents the flow temperature. The outdoor temperature is measured by a Pt 100 sensor and converted into a flow temperature through function generation. The relationship between outdoor temperature and required flow temperature is given in the table below. The resulting characteristic serves as external reference variable. The Type 6493-01 Compact Controller controls the valve via a three-step signal with internal position feedback.

Proceed as follows:

- The controlled variable X represents the flow temperature, which is measured by a two-wire transmitter. In controller version 6493-01, two-wire transmitters can only be connected to the input In1. This input is adjusted to 4 to 20 mA by default, i.e. it does not need to be changed. However, you have to adjust the measuring range for this input to a range of 0 to 150 °C. Additionally, you must assign the controlled variable X to input In1.
- The outdoor temperature is represented by the external reference variable WE and applied to the input In2. This input is already set up for Pt 100 sensors by default. The measuring range is also fixed. Nevertheless, you have to assign WE to input In2. By default, WE is not activated. Set the measuring range for the internal reference variable W to 0 to 150 °C as well. In operating level, you may choose between W and WE. When selecting WE as active reference variable, follow-up control is implemented automatically.
- Define the relationship between outdoor temperature and flow temperature in the main group IN with the function FUNC and WE in the parameter level.

t_A in °C	(K1.X to K7.X)	–20.0	–10.0	0.0	10.0	20.0	30.0	40.0
t_V in °C	(K1.X to K7.X)	100.0	90.0	85.0	75.0	60.0	55.0	50.0

- Select a three-step signal with internal position feedback as output.

The following table lists the required settings:

Setup level

Main group	Function -CO-		Setting	Parameter -PA-	Value	Comment
IN	-CO- IN1		4-20 mA (default)	⊻IN1 ⊼IN1	0.0 [°C] 150.0 [°C]	Define measuring range for input 1 (tv)
	-CO- CLAS	X	In1			Assign controlled variable X (tv) to input In1
		WE	In2			Assign external reference variable WE (tA) to input In2
	-CO- FUNC	WE	on	MIN MAX K1.X K1.Y K2.X K2.Y K3.X K3.Y K4.X K4.Y K5.X K5.Y K6.X K6.Y K7.X K7.Y	0.0 [°C] 150.00 [°C] –20.0 [°C] 100.0 [°C] –10.0 [°C] 90.0 [°C] 0.0 [°C] 85.0 [°C] 10.0 [°C] 75.0 [°C] 20.0 [°C] 60.0 [°C] 30.0 [°C] 55.0 [°C] 40.0 [°C] 50.0 [°C]	Activate function generation for WE. Define measuring range for output signal tv obtained by function generation. Indicate 7 pairs of values which determine the relationship between outdoor and flow temperature.
SETP	-CO- SP.VA	WE	on			Activate WE and follow-up control with it
		W	on (factory default)	W ⊻WINT ⊼WINT	25 [°C] 0 [°C] 150 [°C]	Define value for internal variable W and measuring range of W
CNTR	-CO- C.PID		PI (factory default)	KP TN TV	0.8 16.0 6.0	Specify control parameters.

Setup level

Main group	Function -CO-	Setting	Parameter -PA-	Value	Comment
OUT	-CO- C.OUT	3.STP i.FB	XSDY TZ TY	0.8 [%] 2.0 [%] 90.0 [s]	Define three-step output with internal position feedback and appropriate parameters.
Operating level					
Press selector key to view WE. Press enter key.					Define WE as active reference variable.

5 Start-up

When all the inputs and outputs as well as the power supply are connected, the compact controller must be adapted to the desired control task. This means that you have to configure and parameterize the controller. Appendix C contains a checklist to fill in the adjusted settings if you wish.

The compact controller must be adapted to the dynamic behavior of the controlled system via the parameters KP, TN and TV to ensure that the system deviations caused by disturbances can be eliminated or largely suppressed. There are two ways to adjust these parameters, either via start-up adaption (see section 3.8.1) or via manual optimization. The latter is described in the following sections. We can only give general instructions. If appropriate settings have not yet been determined for your controlled system, proceed as follows:

Note! Make sure the connected control valve is closed before you start manual optimization!

1. Press the manual/automatic key (13) to switch to manual mode. The ⩫ icon is displayed.
2. Use the cursor keys to change the output variable to a value at which the control valve slowly opens.
3. Proceed as described below for the desired control action.

5.1 P controller

- Enter KP = 0.1.
- Adjust the reference variable to the desired value in operating level.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and the error Xd becomes approximately zero.
- Switch to automatic mode.
- Increase the KP value until the controlled system tends to oscillate.
- Slowly decrease the KP value until the oscillations are eliminated.
- To eliminate the remaining system deviation, proceed as follows: switch to manual mode. Change the output variable so that the error Xd = 0. Read the value displayed for the output variable and adjust the parameter Y.PRE (CNTR, C.PID) to this value.

Note! *Each change of the reference variable also changes the operating point!*

5.2 PI controller

- Enter KP = 0.1 and TN = 1999.
- Adjust the reference variable to the desired value in operating level.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and the error Xd becomes approximately zero.
- Switch to automatic mode.

- Increase the KP value until the controlled system tends to oscillate.
- Slightly decrease the KP value until the oscillations are eliminated.
- Decrease the TN value until the controlled system tends to oscillate.
- Slightly increase the TN value until the oscillations are eliminated.

5.3 PD controller

- Enter KP = 0.1, TV = 1 and derivative-action gain TVK1 = 1.
- Adjust the reference variable to the desired value in operating level.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and the error Xd becomes approximately zero.
- Switch to automatic mode.
- Increase the KP value until the controlled system tends to oscillate.
- Increase the TV value until the oscillations are eliminated.
- Increase the KP value until the oscillations appear again.
- Increase the TV value further until the oscillations are eliminated.
- Repeat this procedure several times until the oscillations can no longer be suppressed.
- Slightly decrease the KP and TV values to allow the controlled system to settle down.
- To eliminate the remaining system deviation, proceed as follows: switch to manual mode. Change the output variable until the error Xd = 0. Read the value displayed for the output variable and adjust the parameter Y.PRE (CNTR, C.PID) to this value.

Note! *Each change of the reference variable also changes the operating point!*

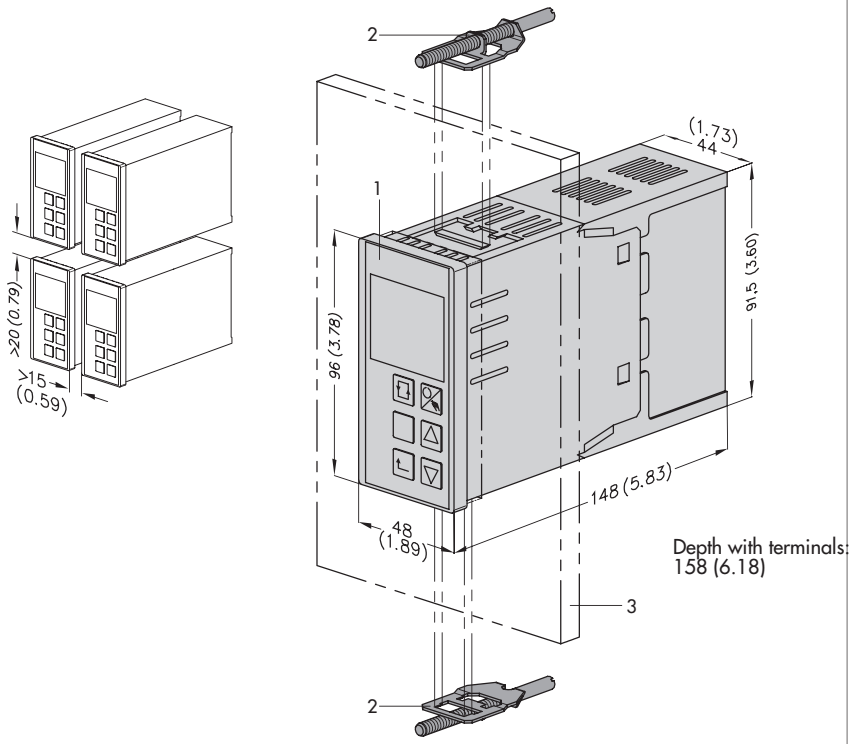
5.4 PID controller

- Enter KP = 0.1, TN = 1999 and TV = 1.
- Adjust the reference variable to the desired value.
- Use the cursor keys to change the output variable to a value at which the control valve slowly opens and the error Xd becomes approximately zero.
- Switch to automatic mode.
- Increase the KP value until the controlled system tends to oscillate.
- Increase the TV value until the oscillations are eliminated.
- Increase the KP value until the oscillations appear again.
- Increase the TV value until the oscillations are eliminated.
- Repeat this procedure several times until the oscillations can no longer be suppressed.
- Slightly decrease the KP and TV value to allow the controlled system to settle down.
- Decrease the TN value until the controlled system tends to oscillate again. Now increase the value again slightly, so that the oscillations disappear.

6 Installation

The TROVIS 6493 Compact Controller is a panel-mounting unit with front dimensions of 48 mm x 96 mm. To mount the controller, proceed as follows:

1. Make a control panel cut-out with dimensions of $45^{+0.6}$ x $92^{+0.8}$ mm.
2. Push the controller into the panel cut-out so that its front panel goes through first.
3. Insert the provided mounting brackets (2) into the remaining slots between the upper and lower edge of the controller front and the panel cut-out (see Fig. 22).
4. Screw the threaded rods towards the control panel using a screwdriver until the housing is clamped against the control panel.



1 Compact controller
2 Mounting bracket
3 Control panel

Panel cut-out: $45^{+0.6}$ x $92^{+0.8}$ mm ($1.77^{+0.023}$ x $3.622^{+0.0315}$ inch)

Fig. 22 · Installation with dimensions in mm (inch)

7 Electrical connections

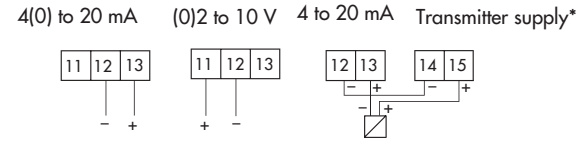
The compact controller has screw terminals suitable for lines up to 1.5 mm².

For electrical installation, you are required to observe the VDE 0100 regulation and the regulations applicable in the country of usage.

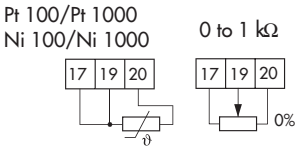
To avoid measurement errors or other faults, use screened cables for the signal lines of the analog and binary inputs running outside the switching cabinets. Within the cabinets, these signal lines have to be installed separately from the control and network lines with sufficient space between them.

Ground the cable screenings on one side in the neutral point of the measuring and control system.

Input IN1



Input IN2 (version 6493-01)



* Note! The transmitter supply can only be used for **one** two-wire transmitter (at IN1 **or** at IN2) **or** for the supply of the binary input B1.

Input IN2 (version 6493-02)

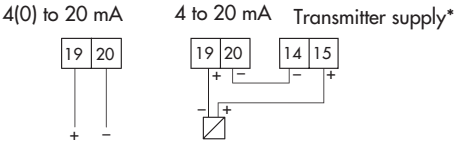
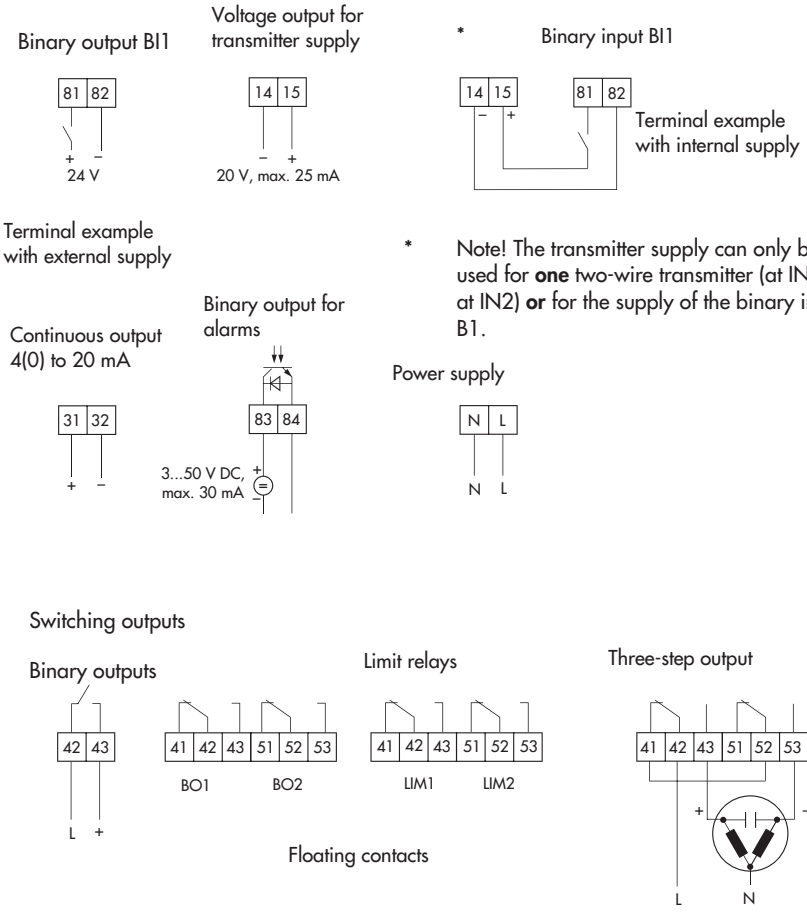


Fig. 23 · Electrical connections



* Note! The transmitter supply can only be used for **one** two-wire transmitter (at IN1 **or** at IN2) **or** for the supply of the binary input B1.

Fig. 24 · Electrical connections (continued)

8 Technical data

Inputs		Two analog inputs, optionally for controlled variable X or reference variable W
Analog input 1 Analog input 2 (two controller versions)		0(4) to 20 mA or 0(2) to 10 V or two-wire transmitter (see below)
		Version 6493-01: temperature sensor or potentiometer (see below) Version 6493-02: 0(4) to 20 mA or two-wire transmitter (see below)
Input for mA or V	Measuring ranges	0(4) to 20 mA or 0(2) to 10 V
	Measuring range changeover	Performed by software
	Maximum permissible values	Current ± 50 mA, voltage ± 25 V
	Internal resistance	Current R_i = 50 Ω, voltage R_i = 20 kΩ
	Permissible common mode voltage	0 to 5 V
	Error	Zero < 0.2 %, span < 0.2 %, linearity < 0.2 %
	Temperature influence	Zero < 0.1 %/10 K, span < 0.1 %/10 K
Transmitter supply		Acc. to DIN IEC 381 (NAMUR NE 06) 20 V, max. 25 mA, resistant to short circuit
Temperature sensor	Measuring range	Pt 100, Pt 1000: – 100 °C to 500 °C Ni 100, Ni 1000: –60 °C to 250 °C
	Wire resistance	Three-wire cable $R_{L1} = R_{L2} = R_{L3}$ < 15 Ω
	Error	Zero < 0.1 %, gain < 0.1 %, linearity < 0.1 %
	Pt 100, Pt 1000 in the range between –40 and 150 °C	Zero < 0.2 %, gain < 0.2 %, linearity < 0.2 %
	Temperature influence	Zero < 0.2 %/10 K, span < 0.2 %/10 K
Potentiometers	Measuring range	0 to 1 kΩ, three-wire
	Wire resistance	R_L < 15 Ω each
	Error	Zero < 0.2 %, gain < 0.2 %
	Temperature influence	Zero < 0.1 %/10 K, gain < 0.2 %/10 K
Binary input		External switching voltage 24 V DC, ± 30 %; 3 mA
Outputs		Optionally continuous-action, on/off or three-step output
Continuous-action output	Signal range	0(4) to 20 mA, load < 740 Ω
	Control range	0 to 22 mA (0 to 110 %)

	Error	Zero < 0.2 %, gain < 0.1 %
	Temperature influence	Zero < 0.1 %/10 K, span < 0.1 %/10 K
Switching output		2 relays with floating switching contact Max. 250 V AC, max. 250 V DC, max. 1 A AC, max. 0.1 A DC, cos θ = 1
	Spark suppression	C = 2.2 nF and varistor U = 275 V
Binary output		Isolated transistor output, max. 50 V DC and 30 mA, min. 3 V DC
Infrared interface		
Transfer protocol		SAMSON protocol (SSP)
Transfer rate		9600 bit/s
Angle of reflection		50°
Distance		Max. 0.7 m
General specifications		
Display		4-digit LCD
Configuration		Function blocks saved in read-only memory for fixed set point and follow-up control
Power supply		90 to 250 V AC, 47 to 63 Hz 24 V AC (21.5 to 26.5 V AC), 48 to 62 Hz
Power consumption		13 VA (90 to 250 V AC), 6 VA (24 V AC)
Temperature range		0 °C to 50 °C (operation), –20 °C to 70 °C (shipping and storage)
Degree of protection		Front panel IP 65, housing IP 30, terminals IP 00
Device safety		Design and testing according to EN 61010: 1994
Protection class		II
Overvoltage category		II
Degree of contamination		2
Noise emission		EN 61000-6-3
Noise immunity		EN 61000-6-2:2006
Electrical connection	Supply voltage and process signals	1.5 mm² screw terminals
Total delay time		≤ 100 ms
Resolution		Input: 0.1 °C; 0.1 %
Dimensions		See dimensions diagram
Weight		Approx. 0.5 kg

Appendix A

Appendix A Table of functions and parameters

Main group	Function -CO-	Displayed settings	KEY [1]	Setting options	Description of function	*Details*	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
Control parameter											
PAR	(Press enter key only once to get to Kp).					p. 18		KP TN TV Y.PRE	Proportional-action coefficient Reset time Derivative-action time Y rate action	0.1… 100.0 [1] 1…9999 [s] 1…9999 [s] –10 ... 110.0 [%]	1.0 120 10 0.0
Input functions											
IN	-CO- IN1	4 -20 mA	[1]	4-20 mA 0-10 V 2-10 V 0-20 mA	**Input signal range IN1** 4-20 mA ~ 0-10 V ~ 2-10 V ~ 0-20 mA	p. 20	-PA- IN1/mA -PA- IN1/mA -PA- IN1/V -PA- IN1/V	⩡ IN1 ⩠ IN1	Lower range value Upper range value	–999… ⩠ IN1 ⩡ IN1…9999 [absolute][3]	0.0 100.0
	-CO- IN2 6493-01	100 PT	[1]	100 PT 1000 P T 100 NI 1000 NI 0-1 KOHM	**Input signal range IN2** Pt 100 (–100…500 °C) ~ Pt 1000 (–100…500 °C) ~ Ni 100 (–60…250 °C) ~ Ni 1000(–60…250 °C) ~ 0 to 1000 Ω	p. 20	-PA- IN2/PT -PA- IN2/PT -PA- IN2/NI -PA- IN2/NI -PA- IN2/KOHM	⩡ IN2 ⩠ IN2	Lower range value Upper range value	–999… ⩠ IN2 ⩡ IN2…9999 [absolute][3]	–100 500
	-CO- IN2 6493-02	4 -20 mA		4-20 mA 0-20 mA	**Input signal range IN2** 4-20 mA ~ 0-20 mA	p. 20	-PA- IN1/mA -PA- IN1/mA	⩡ IN2 ⩠ IN2	Lower range value Upper range value	–999… ⩠ IN2 ⩡ IN2…9999 [absolute][3]	 0.0 100.0
	-CO- MEAS	oFF ME.MO	[1]	oFF ME.MO IN1 ME.MO IN2 ME.MO ALL ME.MO	**Measuring range monitoring** analog inputs off ~ analog input 1 ~ analog input 2 ~ analog inputs 1 and 2	p. 21	noPA MEAS/ME.MO		No parameters		
	-CO- MAN	FAIL oFF	[1]	oFF FAIL F01 FAIL F02 FAIL	**Changeover to manual mode upon transmitter failure** off ~ with constant output value Y1K1 ~ with last output value received	p. 21	-PA- MAN/FAIL	Y1K1	Constant output value	–10.0…110.0 [%]	–10.0
	-CO- CLAS	IN2 X	[1]	IN2 X IN1 X	**Assignment of X** to analog input IN2 ~ to analog input IN1		noPA CLAS/X		No parameters		
		IN1 WE	[1]	IN1 WE IN2 WE	**Assignment of WE** to analog input IN1 ~ to analog input IN2	p. 22	noPA CLAS/WE		No parameters		

1) All functions and parameters can be read without the key number. Only when changing functions or parameters for the first time, you are prompted to enter the key number.

2) Range of values is identical to that of the assigned input.

3) Decimal place depends on the DP function (main group AUX).

4) The parameter values in brackets only apply to controller version 6493-02.

Appendix A

Main group	Function -CO-	Displayed settings	KEY [1]	Setting options	Description of function	*Details*	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
IN (continued)	-CO- DI.FI	on X	[1]	on X oFF X	**Filtering of input variable X** on ~ off		-PA- DI.FI/X	TS.X	Time constant of X filter	0.1… 100.0 [s]	1.0
		oFF WE	[1]	oFF WE on WE	**Filtering of input variable WE** off ~ on	p. 22	-PA- DI.FI/WE	TS.WE	Time constant of WE filter	0.1… 100.0 [s]	1.0
	-CO- SQR	oFF X	[1]	oFF X on X	**Root extraction of input variable X** off ~ on		no PA SQR/X				
		oFF WE	[1]	oFF WE on WE	**Root extraction of input variable WE** off ~ on	p. 23	no PA SQR/WE				
	-CO- FUNC	oFF X	[1]	oFF X on X	**Function generation of X** off ~ on	p. 23	-PA- FUNC/X	MIN MAX K1.X K1.Y K2.X K2.Y K3.X K3.Y K4.X K4.Y K5.X K5.Y K6.X K6.Y K7.X K7.Y	Output signal lower range value Output signal upper range value Input value point 1 Output value point 1 Input value point 2 Output value point 2 Input value point 3 Output value point 3 Input value point 4 Output value point 4 Input value point 5 Output value point 5 Input value point 6 Output value point 6 Input value point 7 Output value point 7	-999… 9999 [absolute][3] X values (e.g. K1.X): ⩡IN1… ⩠IN1 or [2] ⩡IN2… ⩠IN2 Y values (e.g. K1.Y): MIN…MAX	0.0 100.0 –100.0 0.0 –100.0 0.0 –100.0 0.0 –100.0 0.0 –100.0 0.0 –100.0 0.0 –100.0 0.0

1) All functions and parameters can be read without the key number. Only when changing functions or parameters for the first time, you are prompted to enter the key number.

2) Range of values is identical to that of the assigned input.

3) Decimal place depends on the DP function (main group AUX).

4) The parameter values in brackets only apply to controller version 6493-02.

Main group	Function -CO-	Displayed settings	KEY [1]	Setting options	Description of function	*Details*
IN (continued)		oFF WE	[1]	oFF WE on WE	**Function generation of WE** off ~ on	p. 23

Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
-PA- FUNC/WE	MIN	Output signal lower range value	-999… 9999	0.0
	MAX	Output signal upper range value	[absolute][3]	100.0
	K1.X	Input value point 1		0.0
	K1.Y	Output value point 1	X values	0.0
	K2.X	Input value point 2	(e.g. K1.X):	0.0
	K2.Y	Output value point 2	⩡IN1… ⩠IN1	0.0
	K3.X	Input value point 3	or [2]	0.0
	K3.Y	Output value point 3	⩡IN2… ⩠IN2	0.0
	K4.X	Input value point 4		0.0
	K4.Y	Output value point 4	Y values	0.0
	K5.X	Input value point 5	(e.g. K1.Y):	0.0
	K5.Y	Output value point 5	MIN…MAX	0.0
	K6.X	Input value point 6		0.0
	K6.Y	Output value point 6		0.0
	K7.X	Input value point 7		0.0
	K7.Y	Output value point 7		0.0

1) All functions and parameters can be read without the key number. Only when changing functions or parameters for the first time, you are prompted to enter the key number.

2) Range of values is identical to that of the assigned input.

3) Decimal place depends on the DP function (main group AUX).

4) The parameter values in brackets only apply to controller version 6493-02.

Appendix A

Main group	Function -CO-	Displayed settings	KEY	Setting options	Description of function	Details	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
Reference variable											
SETP	-CO- SP.VA	on W	[1]		**Internal reference variable W** (always active)		-PA- SP.VA/W	W	Internal reference variable 1	⧩WRAN… ⧨WRAN [1]	–100.0 (0.0)[4]
								⧩ WINT	Lower range value W, W2, WE	–999… ⧨WINT [1]	–100.0 (0.0)[4]
								⧨WINT	Upper range value for W, W2, WE	⧩WINT… 9999 [1]	500.0 (100.0)[4]
								⧩WRAN	Limitation of lower range value	⧩WINT… ⧨WRAN [%]	–100.0 (0.0)[4]
								⧨WRAN	Limitation of upper range value	⧩WRAN… ⧨WINT [absolute][3]	500.0 (100.0)[4]
		oFF W2	[1]	oFF W2 onW2	**Internal reference variable W2** off ~ on		-PA- SP.VA/W2	W2	Internal reference variable W2	⧩WRAN… ⧨WRAN [absolute][3]	–100.0 0.0
		oFF WE	[1]	oFF WE on WE F01 WE F02 WE	**External reference variable WE** off ~ on ~ input for ext. position feedback with 3-step output ~ input for feedforward control	p. 27	noPA SP.VA/WE		No parameters		
	-CO- SP.FU	oFF RAMP	[1]	oFF RAMP F01 RAMP F02 RAMP F03 RAMP	**Set point ramp** off ~ starts with BI and meas. value ~ starts with BI and WIRA ~ without starting conditions		-PA- SP.FU/RAMP	TSRW WIRA	Time parameter Initial value for reference variable	1… 9999 [s] ⧩WINT… ⧨WINT [absolute][3]	10 –100.0 (0.0)[4]
		oFF CH.SP	[1]	oFF CH.SP F01 CH.SP F02 CH.SP	**Changeover W(W2)/WE via BI** off ~ W(W2)/WE via BI ~ W/W2 via BI *28*	p. 28	noPASP.VA/CH.SP		No parameters		

1) All functions and parameters can be read without the key number. Only when changing functions or parameters for the first time, you are prompted to enter the key number.

2) Range of values is identical to that of the assigned input.

3) Decimal place depends on the DP function (main group AUX).

4) The parameter values in brackets only apply to controller version 6493-02.

Main group	Function -CO-	Displayed settings	KEY	Setting options	Description of function	Details	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
Control structure and functions											
CNT	-CO- C.PID	PI CP.YP	1)	PI CP.YP Pd CP.YP PId CP.YP PPI CP.YP P CP.YP	**Dynamic behavior of controller output** PI ~ PD ~ PID ~ P^2I ~ P	p. 29	-PA- C.PID/CP.YP	KP TN TV TVK1 Y.PRE DZXD ⌄DZXD ⌃DZXD	Proportional-action coefficient Reset time Derivative-action time Derivative-action gain Y rate action Dead band of error XD Limitation of XD min. Limitation of XD max.	0.1… 100.0 [1] 1…9999 [s] 1…9999 [s] 0.10…10.00 [1] –10.0… 110.0 [%] 0.0… 110.0 [%] –110… ⌃DZXD [%] ⌄DZXD…110 [%]	1.0 120 10 1.00 0.0 0.0 –110.0 110.0
	-CO- SIGN	dir.d XD	1)	dir.d XD in.d XD	**Inversion error Xd** without With ~	p. 31	noPA SIGN/XD		No parameters		
	-CO- D.PID	F01 DP.YP	1)	 F01 DP.YP F02 DP.YP	**Assignment of controller output D element** ~ to error ~ to controlled variable	p. 31	noPA D.PID/DP.YP		No parameters		
	-CO- CH.CA	oFF CC.P/	1)	oFF CC.P/ F01 CC.P/ F02 CC.P/	**Control mode changeover P(D)/PI(D) control** off ~ via error ~ via reference variable	p. 32	-PA- CH.CA/CC.P/	CLI.P CLI.M	Maximum limit Minimum limit for PI(D) control	0.0… 110.0 [%] –110… 0.0 [%]	110.0 –110
	-CO- M.ADJ	oFF MA.YP	1)	 oFF MA.YP on MA.YP	**Operating point adjustment in manual mode for Y_{PID}** ~ off ~ on	p. 33	noPA M.ADJ/MA.YP		No parameters		
	-CO- DIRE	dir.d DI.AC	1)	dir.d DI.AC in.d DI.AC	**Operating direction of output variable** direct ~ inverted	p. 33	noPA DIRE/DI.AC		No parameters		
	-CO- F.FOR	oFF FECO	1)	oFF FECO P05 FECO nE6 FECO	**Feedforward control** deactivated ~ with positive sign ~ with negative sign	p. 33	-PA- F.FOR/FECO	 FC.K1 FC.K2 FC.K3	± (WE – FC.K1) FC.K2 + FC.K3 Constant Constant Constant	 0.0… 110.0 [%] 0.0… 10.0 [1] –10.0 …110.0 [%]	 0.0 1.0 0.0
	-CO- AC.VA	oFF IN.DE	1)	oFF IN.DE bi1 IN.DE	**Increase, decrease of actual value** deactivated ~ via binary input BI	p. 34	-PA- AC.VA/IN.DE	AV.K1	Constant	–110 …110.0 [%]	0.0

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3) Decimal place depends on the DP function (main group AUX).

4) The parameter values in brackets only apply to controller version 6493-02.

Main group	Function -CO-	Displayed settings	KEY	Setting options	Description of function	Details	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
Output functions											
OUT	-CO- SAFE	oFF SA.VA	1)	oFF SA.VA bi1 SA.VA	**Initialization of constant output value Y1K1 for Y_{PID}** off ~ via binary input BI	p. 35	-PA- SAFE/SA.VA	Y1K1	Constant output value	–10.0…110 [%]	–10.0
	-CO- MA.AU	oFF CH.MA	1)	oFF CH.MA bi1 CH.MA	**Manual/automatic changeover** off ~ via binary input BI*35*	p. 35	noPA MA.AU/CH.MA		No parameters		
	-CO- Y.LIM	on LI.YP	1)	on LI.YP	**Output signal limitation Y_{PID}** activated	p. 37	-PA- Y.LIM/ LI.YP	⩡ Y ⩠ Y	Minimum output variable Maximum output variable	–10.0…110 [%]	-10.0 110.0
	-CO- RAMP	oFF RA.YP	1)	oFF RA.YP F01 RA.YP F02 RA.YP F03 RA.YP F04 RA.YP F05 RA.YP	**Output ramp or limitation of rate of output changes Y_{PID}** off Increasing ramp, starts with -10% via binary input Increasing/decreasing ramp, starts with Y1RA via binary input Limitation for increasing and decreasing ramp Limitation for increasing ramp Limitation for decreasing ramp	 p.37	-PA- RAMP/RA.YP	TSRA Y1RA	Transit time of ramp Initial value for ramp	1… 9999 [s] –10.0… 110.0 [%]	1 -10.0
	-CO- BLOC	oFF BL.YP	1)	oFF BL.YP bi1 BL.Y	**Locking of output signal Y_{PID}** off ~ via binary input BI		noPA BLOC/BL.YP		No parameters		
	-CO- FUNC	oFF FU.YP	1)	oFF FU.YP on FU.YP	**Function generation of controller output** off ~ on	p. 39	-PA- FUNC/FU.YP	K1.X K1.Y K2.X K2.Y K3.X K3.Y K4.X K4.Y K5.X K5.Y K6.X K6.Y K7.X K7.Y	Input value point 1 Output value point 1 Input value point 2 Output value point 2 Input value point 3 Output value point 3 Input value point 4 Output value point 4 Input value point 5 Output value point 5 Input value point 6 Output value point 6 Input value point 7 Output value point 7	X values (K1.X…): –10.0… 110.0 [%] Y values (K1.Y…): –10.0… 110.0 [%]	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
	-CO- Y.VA	4-20 mA	1)	0-20 mA 4-20 mA oFF Y	**Output signal range** 0 to 20 mA ~ 4 to 20 mA No continuous-action output	p. 39	no PA Y.VA/Y no PA Y.VA/mA no PA Y.VA/mA		No parameters		

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3) Decimal place depends on the DP function (main group AUX).

4) The parameter values in brackets only apply to controller version 6493-02.

Main group	Function -CO-	Displayed settings	KEY	Setting options	Description of function	Details	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
OUT (continued)	-CO- Y.SRC	on Y.PID	1)		**Assignment of continuous-action output**	p. 40	no PA Y.SRC/Y.PID		No parameters		
				on Y.PID	~ to PID output		no PA Y.SRC/Y.X				
				on Y.X	~ to X input		no PA Y.SRC/ Y.WE				
				on Y.WE	~ to WE input for feedforward control		no PA Y.SRC/ Y.XD				
				on Y.XD	~ to error Xd						
	-CO- CALC	on CA.Y	1)		**Mathematical adaption of controller output Y**	p. 40	-PA- CALC/CA.Y		$Y_2 = (\|Y_1 - CA.K1\|)\ CA.K2 + CA.K3$		
				on CA.Y	~ without condition			CA.K1	Constant	0.0… 100.0 [%]	0.0
				oFF CA.Y	~ deactivated (no output signal!)			CA.K2	Constant	0.0… 10.0 [1]	1.0
				POS CA.Y	~ with positive sign			CA.K3	Constant	–10.0…110.0 [%]	0.0
				nE6 CA.Y	~ with negative sign						
	-CO- C.OUT	oFF 2/3.S	1)	oFF 2/3.S	**Configuration of two-step or three-step output** off	p. 41	-PA- C.OUT/2/3.S	KPL1	Gain for BO1	0.1… 100.0 [1]	1.0
				on 2.STP	Two-step output		-PA- C.OUT/2.STP	KPL2	Gain for BO2	0.1… 100.0 [1]	1.0
				i.Fb 3.STP	Three-step output with internal position feedback		-PA- C.OUT/3.STP	TYL1	Duty cycle for BO1	0.1… 9999 [s]	10.0
				E.Fb 3.STP	Three-step output with external position feedback		-PA- C.OUT/3.STP	TYL2	Duty cycle for BO2	0.1… 9999 [s]	10.0
				PP 2.STP	Two-step output with pulse-pause modulation (PPM)		-PA- C.OUT/2.STP	⧗TYL1	Minimum on-time of BO1	0.1… TYL1[%]	1.0
				i.PP 3.STP	Three-step output with internal pos. feedback + PPM		-PA- C.OUT/3.STP	⧗TYL2	Minimum on-time of BO2	0.1… TYL2 [%]	1.0
				E.PP 3.STP	Three-step output with external pos. feedback + PPM		-PA- C.OUT/3.STP	XSDY	Diff. gap of 2-step/3-step output	0.10… TZ [%]	0.5
								TZ	Dead band 3-step output	XSDY… 100.0 [%]	2.0
								TY	Transit time	1… 9999 [s]	60
	-CO- B.OUT	oFF B.BO1	1)	oFF B.BO1	**Configuration binary output BO1** deactivated		noPA OUT1/B.BO1		No parameters		
				F01 B.BO1	Active when binary input activated						
				F02 B.BO1	Active when WE activated						
				F03 B.BO1	Active in automatic mode						
		oFF B.BO2	1)	oFF B.BO2	**Configuration binary output BO2** deactivated	p. 50	noPA OUT1/B.BO2		No parameters		
				F01 B.BO2	Active when binary input activated						
				F02 B.BO2	Active when WE activated						
				F03 B.BO2	Active in automatic mode						

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Main group	Function -CO-	Displayed settings	KEY	Setting options	Description of function	Details	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
Alarm functions											
ALRM	-CO- LIM1	oFF L1	1)	oFF L1	**Limit relay L1** deactivated	p.52					
				Lo L1.X	L1 activated when X is not reached		-PA- LIM1/L1.X	LI.X	Limit for X	⧩IN1…⧨IN1	500.0
				Hi L1.X	L1 activated when X is exceeded				or	⧩IN2…⧨IN2 2),3)	(100.0)
				Lo L1.WE	L1 activated when WE is not reached		-PA- LIM1/L1.WE	LI.WE	Limit for WE	⧩IN1…⧨IN1	4 100.0
				Hi L1.WE	L1 activated when WE is exceeded				or	⧩IN2…⧨IN2 2), 3)	
				Lo L1.YP	L1 activated when Y_{PID} is not reached		-PA- LIM1/L1.YP	LI.YP	Limit for YPID	⧩Y … ⧨ Y [%]	100.0
				Hi L1.YP	L1 activated when Y_{PID} is exceeded						
				Lo L1.XD	L1 activated when + XD is not reached		-PA- LIM1/L1.XD	LI.XD	Limit for XD	–110… 110.0 [%]	0.0
				Hi L1.XD	L1 activated when –XD is exceeded						
				Ab S L1.XD	L1 activated when amount of XD is exceeded			L.HYS	Differenial gap	0.10…100.0 [%]	0.5
	-CO- LIM2	oFF L2	1)	oFF L2	**Limit relay L2** deactivated	p.52					
				Lo L2.X	L2 activated when X is not reached		-PA- LIM2/L2.X	LI.X	Limit for X	⧩IN1…⧨IN1	500.0
				Hi L2.X	L2 activated when X is exceeded				or	⧩IN2…⧨IN2 2), 3)	(100.0)4
				Lo L2.WE	L2 activated when WE is not reached		-PA- LIM2/L2.WE	LI.WE	Limit for WE	⧩IN1…⧨IN1	100.0
				Hi L2.WE	L2 activated when WE is exceeded				or	⧩IN2…⧨IN2 2),3)	
				Lo L2.YP	L2 activated when Y_{PID} is not reached		-PA- LIM2/L2.YP	LI.YP	Limit for Y_{PID}	⧩Y … ⧨Y [%]	110.0
				Hi L2.YP	L2 activated when Y_{PID} is exceeded						
				Lo L2.XD	L2 activated when + XD is not reached		-PA- LIM2/L2.XD	LI.XD	Limit for XD	–110… 110.0 [%]	0.0
				Hi L2.XD	L2 activated when –XD is exceeded						
				Ab S L2.XD	L2 activated when amount of XD is exceeded			L.HYS	Differenial gap	0.10…100.0 [%]	0.5

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2) Range of values is identical to that of the assigned input.

3) Decimal place depends on the DP function (main group AUX).

4) The parameter values in brackets only apply to controller version 6493-02.

Main group	Function -CO-	Displayed settings	KEY	Setting options	Description of function	Details	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
Additional functions											
AUX	-CO- RE.CO	F01 MODE	1)	F01 MODE F02 MODE F03 MODE	**Restart conditions after power failure** Manual mode and with constant output value Y1K1 Automatic mode with last reference variable value received and Y1K1, without confirmation Automatic mode with last reference variable value received and Y1K1, confirmation required	p. 53	-PA- RE.CO/MODE	Y1K1	Constant output value	–10.0…110 [%]	–10.0
	-CO- ST.IN	FrEE INIT	1)	FrEE INIT All INIT FUnC INIT PArA INIT AdJ INIT	**Resetting to factory defaults** deactivated/completed ~ all functions, parameters and the key number ~ all functions ~ all parameters Basic initialization of calibrating values for IN1, IN2, Y	p. *54*	noPA ST.IN/INIT		No parameters		
	-CO- KEYL	oFF LOCK	1)	oFF LOCK bi1 LOCK on noH.W	**Operator keys** enabled ~ enable/disable via BI Selector key, manual/automatic key and cursor keys disabled	p. *54*	noPA KEYL/LOCK		No parameters		
	-CO- VIEW	06 VIEW	1)	06 VIEW 07 VIEW 08 VIEW 09 VIEW 10 VIEW 01 VIEW 02 VIEW 03 VIEW 04 VIEW 05 VIEW	**Display contrast** setting 6 Setting 7 Setting 8 Setting 9 Setting 10 Setting 1 Setting 2 Setting 3 Setting 4 Setting 5	p. 54	noPA		No parameters		
	-CO- FREQ	on 50Hz	1)	on 50Hz on 60Hz	**Power frequency** 50 Hz 60 Hz	p. *55*	noPA FREQ/50Hz		No parameters		
	-CO- DP	on DP1	1)	on DP1 on DP2 on DP0	One **decimal place** Two decimal places No decimal place	p. *55*	noPA DP1		No parameters		

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Appendix A

Main group	Function -CO-	Displayed settings	KEY	Setting options	Description of function	Details	Parameters -PA-	Parameter selection	Parameter designation	Range of values [unit]	Factory default
Start-up adaption											
TUNE	-CO- ADAP	oFF ADP.S	1)	oFF ADP.S run ADP.S	Adaption off Start adaption	p. 55	-PA- ADAP/ADP.S	KP TN TV Y.JMP	Proportional-action coefficient Reset time Derivative-action time Step response value	0.1…100.0 [1] 1.0…9999 [s] 1.0…9999 [s] –100…100.0 [%]	1.0 120.0 1.0 20.0
View process data											
I-O	CIN	FIR	1)		View firmware version	p. 58					
	S-No	____	1)		View serial number	p. 58					
	ANA	IN1 IN2 CO.VA WE.VA FE.CO SP.CO YPID YOUT	3) 3) 3) 3) 3) 3)		View value of analog input 1 View value of analog input 2 View value of contr. var. before function generation View value of ref. var. before function generation View value of WE before applying feedforward control View value of reference variable at comparator View value of Y_{PID} after limitation View value of controller output after mathematical adaption Y_{OUT}	p. 58				–999…9999 [1] –10.0…110.0 [%]	
	BIN	BI1 BO1 BO2	1)		Status binary input BI1 Status binary output BO1 Status binary output BO2	p. 59					
	ADJ	AdJ IN1 AdJ IN2 AdJ YOUT	1)		Adjustment analog input IN1 Adjustment analog input IN2 Adjustment analog output Y	p. 59				–10.0…110.0 [%]	

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Appendix B Error messages

Display blinks	Reason	Remedy
1 ERR	No access to EEPROM	Return device to SAMSON
2 ERR	EEPROM cannot be programmed	Return device to SAMSON
3 ERR	Default settings lost	Return device to SAMSON
4 ERR	Functions changed without user intervention	Check settings of the functions
5 ERR	Parameters changed without user intervention	Check settings of the parameters
6 ERR	Unknown whether external or internal reference variable is to be used	Specify internal or external reference variable
7 ERR	Data of calibration process changed without user intervention	Re-adjust the analog inputs and/or the analog ouputs
30 ERR to 36 ERR	Error during adaption	Refer to page x for more details

In case any of these error messages arises, the binary output is set for alarm messages.

Appendix C Checklist

TROVIS 6493 Compact Controller

Controller no.: Firmware no.:

Date of configuration: Signature:

Main group	Function -CO-	Settings	Parameters
PAR			KP TN TV Y.PRE
IN	IN1		⩡ IN1 ⩠ IN1
	IN2		⩡ IN2 ⩠ IN2
	MEAS		
	MAN		Y1K1
	CLAS	X	
		WE	
	DI.FI	X	TS.X
		WE	TS.WE
	SQR	X	
		WE	

Main group	Function -CO-	Settings	Parameters							
IN (cont.)	FUNC	X	MIN MAX							
				1	2	3	4	5	6	7
			K .X							
			K. Y							
		WE	MIN MAX							
				1	2	3	4	5	6	7
			K .X							
			K. Y							
SETP	SP.VA	W	W ⩡ WINT ⩠ WINT ⩡ WRAN ⩠ WRAN							
		W2	W2							
		WE								
	SP.FU	RAMP	TSRW WIRA							
		CH.SP								
CNTR	C.PID		KP TN TV TVK1 Y.PRE DZXD ⩡ DZXD ⩠ DZXD							
	SIGN									
	D.PID									
	CH.CA		CLI.P CLI.M							

Main group	Function -CO-	Settings	Parameters
CNTR (cont.)	M.ADJ		
	DIRE		
	F.FOR		FC.K1 FC.K2 FC.K3
	AC.VA		AV.K1
OUT	SAFE		Y1K1
	MA.AU		
	Y.LIM		⩡ Y ⩠ Y
	RAMP		TSRA Y1RA
	BLOC		
	FUNC		MIN MAX

	1	2	3	4	5	6	7
K .X							
K. Y							

	Y.VA		
	Y.SRC		
	CALC		CA.K1 CA.K2 CA.K3
	C.OUT		KPL1 KPL2 TYL1 TYL2 MinTYL1 MinTYL2 XSDY TZ TY

Main group	Function -CO-	Settings	Parameters
OUT (cont.)	B.OUT		
ALRM	LIM1		LI.X LI.WE LI.YP LI.XD L.HYS
	LIM2		LI.X LI.WE LI.YP LI.XD L.HYS
AUX	RE.CO		Y1K1
	KEYL		
	VIEW		
	FREQ		
	DP		

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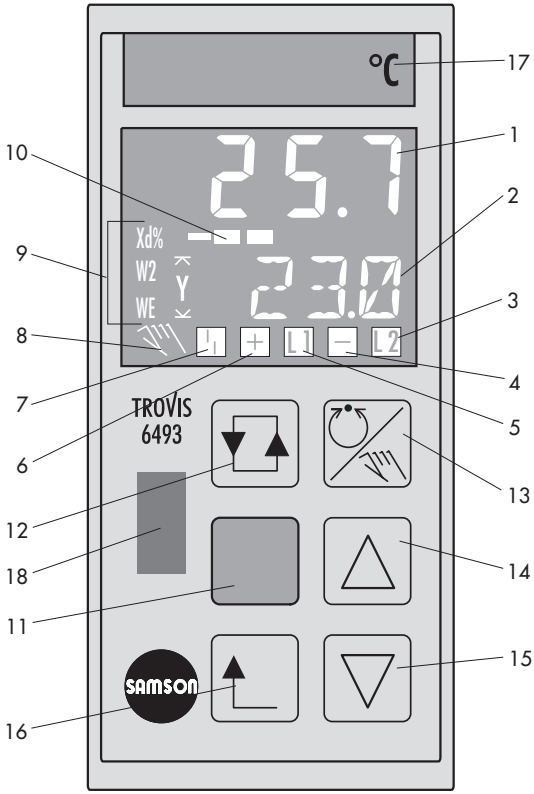
Service key number: 1732



1	Controlled variable X	10	Bar graph Xd in %
2	Value of W, W2, WE, Y or Xd	11	Enter key
3	Limit relay L2 active	12	Selector key
4	Three-point output –	13	Manual/automatic key
5	Limit relay L1 active	14	Cursor key (increase, next)
6	Three-point output +	15	Cursor key (decrease, back)
7	Fault alarm	16	Return key
8	Manual icon	17	Exchangeable label
9	After pressing the selector key, W, W2, WE, Y or Xd reading together with associated value in 2	18	Infrared interface

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